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- Spectral bandwidth 1-3 MHz
- Operating temperature 10 - 40°C
- Compact laser head with dimensions 60 x 62 x 132mm.
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**Cover:** An aerial view of the countryside near Geneva with the underground LEP ring superimposed. [Photo CERN].

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PRESIDENT'S COLUMN

New Millennium, New Team, New AIP

We have now truly started the new millennium and it corresponds with a major changeover of the AIP executive. Let me take this opportunity to applaud the outstanding service rendered to the AIP by the outgoing team.

John Pillbrow has a long association with the executive in that many years ago he served as secretary of the AIP. Undaunted by that experience he returned to be the President and has played an important role in raising the profile of the society in policy making areas of government. David Booth has been a very active and productive Registrar. He has been largely responsible for making the accreditation process work for the benefit of the society and the members. Charles Osborne has rendered the society a great service as treasurer for many years.

The loss of so much experience in one hit could be a cause for concern but the new team has much on its side. There is continuity with the continued membership of Pal Fekete, Moira Welch and yours truly. I have to state very definitely my gratitude to Moira for her willingness to continue. Moira is the AIP's greatest asset and much of her work goes unsung, but it is no less valuable.

The new members of the executive are Rob Elliman, Peter Johnston and Cathy Foley. They bring with them many years of experience, wisdom and competence. All up we now form what has been claimed to be the AIP executive with the youngest average age ever!

So what are we going to do with all this talent and experience? A new AIP. Already the groundwork has been laid in that we now have a new membership database courtesy of David Booth's determination and the work of Pal Fekete and Rod Cross. This will allow us to better serve the needs of the members, the groups and the branches.

We also have forged better links with the IOP which include a new joint membership agreement which brings great benefits to the membership. This deal has proven so popular with our members that it has swamped their administration, so for those of you who received the Physics World early, and the membership details later let me pass on the apologies of the IOP administration. As in future most memberships will be renewals, it will take much less time.

We have other benefits in train so keep an eye on the Physicist for updates. We also have an ambitious program of review and change in place. We aim to deliver more benefits, greater service, more relevance and enhanced visibility. This has to come in stages. Stage one is to increase benefits, gain new sources of income and reduce costs. This will improve our capacity to deliver more to the members. The outcome we plan is a larger, more relevant society meeting all physicists needs.

The recent turn around in government spending must be recognised as one of our benefits to members! The AIP and FASTS have lobbied hard for a reassessment of government policies and we have seen a change. It took time but be assured that without that lobbying it would not have happened. We are not resting on this success. We are encouraged by this change and will continue to lobby for wider support to education, research and technology.

Watch this space!!

John O'Connor
EDITORIAL

Things are Looking Up

There are definite hints of change in the air, as far as physics in Australia is concerned. Prospects for research funding, employment and even student enrolments are all looking up.

First, of course, there is the Federal Government's Innovation Statement, which promises major increases in funding for research and facilities, even though it is spread over a number of years. Labour's "Knowledge Nation" platform means that they are likely to match or even exceed these promises if they win office at the next election. In addition, the large increases promised for defence spending should mean more work for DSTO.

There have also been some causes for optimism on the employment front recently:

- We have heard that the newly-fledged local photonics industry is booming, and is likely to need 5,000 skilled employees within the next 3-4 years;

- There is a continuing demand for qualified graduates in medical physics, which is likely to expand as the population ages and the demand for diagnostic and radiotherapy treatment facilities grows;

- There has been a major uptake of physicists and mathematicians into the financial analysis industry over recent years. In the UK, apparently, approximately one quarter of all physics PhDs are immediately snapped up to work in this area;

- There is an ongoing shortage of IT personnel, so that graduates with skills in this area are assured of a good job;

- There is always a shortage of secondary teachers with scientific training.

In this issue, we carry an article by Tony Butterfield, a "lapsed physicist" who is now an Assistant Commissioner of Taxation. He has some encouraging things to say, pointing out that physicists can and do rise to the top of the tree in many different fields, provided they are willing to be flexible and acquire some extra skills, e.g. in a business or management course. Physics graduates start with a great natural advantage, in that they are trained to be analytical thinkers, and are good at problem solving. Tony remarks that "It is widely believed in some sectors of the financial services industry that a Ph.D. in science is essential for serious risk analysis." So there are many great opportunities for our graduates out in the great world, if they are prepared to be flexible in where they look for a job.

Finally, it seems that undergraduate enrolments have finally stabilized after the long decline of the late 1990s (see the survey by de Laeter and Dekker to follow in a later issue). There seem to be fewer straight Physics majors, but more double-degree students; and 'branded' courses in medical physics, photonics, etc., also seem to be attracting students.

In my personal opinion, we should be offering more double degrees in Science and Computer Science (or etc.). Then our graduates would come out qualified to be IT professionals, with a guaranteed meal ticket as long as IT-qualified graduates are in such short supply. They would also have the prospect of much higher pay rates after graduation: the median salary of pure science graduates is about $45,000, whereas those who majored in IT have median salaries of about $75,000. Hopefully, some of them would still be interested in doing more or less pure science. There is a technical problem here, in that Computer Science is within the Science Faculty in some universities, but sufficiently rare that they can be overcome. I believe this could be a major source of new students.

In any case, the wind now seems to be turning to a more favourable quarter for the profession. We should be trying to get this message across to all our prospective students out there.

Chris Hamner
C.Hamner@unsw.edu.au
LETTER

Arthur Franklin
I am currently completing a historical study on Arthur Franklin AAIP (now MAIP), who was a supporter and member of the Australian Institute of Physics in the period 1950-1972. A full study will be published in a specialist journal on the history of Australian science, and a shorter version has been accepted for publication in The Physicist, appearing hopefully later this year. In his time Arthur Franklin was well known and respected for his contribution to physics as a scientific instrument maker and designer, and as both a company director and managing director in the scientific instrument industry.
Members who remember Arthur Franklin and who have information about him, about his company or about the instruments he made, are invited to contact me at the University of Sydney (by email: mattik@mcch.eng.usyd.edu.au, by mail to the address below or by phone: 9351-7151). I would be very glad to receive any information you may have.

Matti Koentok
School of Aerospace, Mechanical or Mechatronic Engineering,
University of Sydney, NSW 2006

THE 2001 WALTER BOAS MEDAL

Nominations are invited for the award of the 2001 Walter Boas medal of the Australian Institute of Physics and should reach the Honorary Secretary by normal mail at the address below, or by email, by Friday June 29th 2001 at the latest.

The Medal was established in 1984 to promote excellence in research in Physics and to perpetuate the name of Walter Boas. The award is for physics research carried out in the five years prior to the date of the award, as demonstrated by both published papers and unpublished papers prepared for publication, a list of which should accompany the nomination.

Any AIP member may make nominations or may sell nominate for the award. Nominees should be members of the AIP and be Australian citizens and should have been residents of Australia for at least five of the seven years preceding the closing date for nominations.

The Medal shall not be awarded more than once to any person.

Previous winners of the Walter Boas Medal:
1984 Professor Jim Piper, Macquarie University
1985 Dr Peter Hannaford, CSIRO Division of Materials Technology
1986 Professor Don Melrose, Sydney University
1987 Professor Tony Thomas, University of Adelaide
1988 Professor Robert Delbourgo, University of Tasmania
1989 Professor Jim Williams, University of Western Australia
1990 Professor Geoff Opat & Professor Tony Klein, University of Melbourne
1991 Dr P Haripran, CSIRO Division of Applied Physics
1992 Professor B H J McKellar, University of Melbourne
1993 Professor Jim Williams, Australian National University
1994 no medal awarded
1995 A/Professor David Blair, University of Western Australia
1996 Professor Andris Stelbovics, UWA, and Dr Igor Bray, Flinders University
1997 Professor Keith Nugent, U of Melbourne & Dr Stephen Wilkins, CSIRO
1998 Professor Bob Clark, University of NSW
1999 no medal awarded
2000 Professor Hans Bachor, ANU

The award is conditional on the recipient delivering a seminar on the subject of the award at a meeting of the Victorian Branch of the AIP in November 2000. The recipient is also expected to provide a manuscript based on the seminar for publication in The Physicist.

Further details may be obtained from:
The Honorary Secretary
Australian Institute of Physics
PO Box 283, Richmond NSW 2753
Phone: 02 4578 4328 email: m.welch@uws.edu.au

The Physicist Volume 38, Number 2, March/April 2001
AROUND THE TRAPS

Taking the Pulse of a Star
A team led by Dr Tim Bedding at the University of Sydney have made the first precise measurement of surface oscillations on a distant star, Beta Hydri, which lies about 24 light years from the Sun. Using the Anglo-Australian Telescope, light from the star was sampled every two minutes, and the oscillations were measured by a Doppler shift technique. The period was about 17 minutes, corresponding to a star of age 7 billion years.

Dr Bedding said that measurement of these oscillations will be useful in determining the ages of stars. The older the star, the more slowly it oscillates. The team is helping to design a telescope called MONS to be launched on a satellite in 2004, in order to measure more stellar oscillations. The technique could help to resolve an embarrassing discrepancy, that some stars are currently estimated to be older than the Universe.

[Deborah Smith, 'Sydney Morning Herald', January 31]

Bringing Light to a Standstill
Two teams of physicists in the US have performed the remarkable feat of bringing a beam of light to a standstill, capturing it in a gas, and then releasing it unchanged a moment later. The trick could have important applications in the storage and processing of quantum information. Walsworth, Lukin and colleagues at the Harvard-Smithsonian Center for Astrophysics trapped their laser pulses in a gas of rubidium atoms cooled to 70-90K (D.P. Philips et al, Phys. Rev. Letts. 86,783 ('01)). Lele Hau and coworkers at the Rowland Institute for Science and Harvard University used sodium atoms at 0.9 mK (C. Liu et al, Nature 409, 490 ('01)).

In both experiments a "coupling" laser is used to drive transitions between two internal energy levels in the atoms. Then a pulse from a weaker laser is sent in that is resonant between one of these levels and a third level. Quantum interference effects caused by the coupling greatly increase the refractive index and reduce the absorption, slowing the pulse all the way to zero, and trapping it when the coupling laser is switched off. In Hau's experiment a pulse 1.4 km long in free space is stored in a gas cell one half millimetre across. When the coupling laser is switched back on, the pulse is released again with its phase and quantum state intact.

[Peter Rodgers, 'Physics World', Feb 2001]

Demise of the AJP
As foreshadowed in our previous issue, CSIRO Publishing has decided to cease publication of the Australian Journal of Physics. Attempts are being made to place it with another publisher, but if these do not succeed, the journal has published its last issue. This will be seen as a sad event in the history of Australian physics.

Earth is only a Baby
In a paper submitted to the journal Icarus, Charley Lineweaver of the University of NSW opines that Earth-like planets orbiting other stars will be on average 1.8 billion years older than the Earth. This may mean that any intelligent beings that have evolved on these other planets will be so highly advanced that we seem little better than slime mould. No wonder they are not bothering to talk to us!

This startling conclusion was obtained from a study of atomic abundances. Heavy elements such as iron have been getting more plentiful since the Big Bang. Without heavy elements, a rocky planet cannot form; whereas with too many heavy elements, one gets giant 'hot Jupiters' orbiting close to their parent stars, and wiping out any Earths. Lineweaver concludes that three-quarters of all Earth-like planets must have been around longer than the Earth, and their average age is 0.6 billion years, compared with the Earth's 4.6 billion years.

[Marcus Chown, New Scientist, 13 January]

Climate Change
The UN's Intergovernmental Panel on Climate Change (IPCC) have released the first part of their third five-year Report 'Climate Change 2001: The Scientific Basis'. Their statements are unusually blunt, indicating a strong consensus: e.g. "most of the warming [in the last century] is attributable to human activities". Since the 1960s, there has been a 20% decrease in snow cover, and a 40% thinning of the Arctic ice cap. The sea level is predicted to rise by 1cm and 8 cm by 2100, endangering millions of people in low-lying areas. Temperatures will rise between 1.4C and 5.8C in the 21st century, depending on emissions of greenhouse gases.

In Australia, the Panel warns of more frequent extreme weather events: drought, flood, fire and hail. Overall rainfall could decrease by up to 20% by 2070, and water flow in the Murray-Darling basin by 35%

Meanwhile, President George Bush has withdrawn a pledge to regulate power plant emissions of carbon dioxide in the US, in response to lobbying by coal companies and power utilities.

AIP Members Honoured
Professor Bob Crompton has been made an Honorary Fellow of the AIP, bringing the total number of Honorary Fellows to eight. The award was made in recognition of his many contributions to the profession. He was AIP President from 1993 to 1995.

Professor Bob Street was given a special award by both the AIP and the British Institute of Physics at the Congress in Adelaide. He was given the award in recognition of his contributions to magnetism (in the UK before 1960 and in Australia since), his contribution to science in Australia as Chairman of the Australian Research Grants Committee (1972-76), and for his leadership in establishing the Department of Physics at Monash in 1960-73. Under his leadership Monash quickly established a substantial international reputation, particularly in condensed matter physics.
Professor Mike Gore of the ANU has been given the AIP Award for Service to Physics for his work in originating the Questacon and developing it into the National Science Centre in Canberra (see Highlights of the AIP Council Meeting).

Buckyball Dating
Professor Lewis Chadderton of the Research School of Physical Sciences and Engineering at the ANU has predicted that fullerenes (or carbon "buckyballs") could be used in a new method of cosmoligical dating. Prof. Chadderton and his colleagues have described how fullerenes can be created by the passage of heavy, very energetic charged particles. It is now believed that the Big Bang created many WIMPs (weakly interacting massive particles) which could have left trails of fullerenes through the universe. The fullerenes are extremely stable and long-lived, and could be used to date objects on cosmological time scales – billions of years.

[Julian Lee, 'ANU Reporter', 2 March]

Redfern Optics in the Money
The company Redfern Integrated Optics has raised $23.5 million from offshore venture capitalists, even though it is still months away from finalizing its product for commercial sale. RIO will manufacture equipment needed for the latest fibre-optic telecommunications networks. They are able to put a range of optical devices on a single chip, in a breakthrough that will have a "dramatic impact" on the cost, reliability and size of fibre-optic equipment.

RIO is one of five companies that have spun off from the government-funded Photonics Cooperative Research Centre at the Australian Technology Park at Redfern. Staff numbers are planned to rise from 30 to 100 by the end of the year.

[Kirsty Needham, 'Sydney Morning Herald', 15 March]

Olympic fireworks
On the second-to-last day of the Olympics, amateur astronomer Mr Brett White of St Mary's in Sydney discovered an exploding supernova, while peering through his handmade telescope at the Lindfield Observatory. He is one of only about ten people worldwide who have discovered two or more supernovae.

[Richard Macey, 'Sydney Morning Herald']

Cyber High
The Premier of New South Wales, Bob Carr, has announced plans for a new high school for students gifted in computer technology, to cater for the expected boom in IT and communications jobs. A nationwide shortage of 180,000 IT-skilled workers has been forecast within three years.

The Advanced Technology High School will open at the Australian Technology Park in Redfern in 2003, as part of a four-year, $50 million government program. The computer giant Cisco will also invest $8.4 million in the program.

[David Humphries, 'Sydney Morning Herald']

Malcolm McIntosh Prize Nominations
Nominations have been called for the Malcolm McIntosh Prize for achievement in the Physical Sciences. Eligibility is limited to Australian citizens or permanent residents. Nominations should be lodged with the Science Prizes Secretariat, see http://www.isr.gov.au/science.

[This is a prestigious prize bringing great credit to the winners and the institutions they represent.]

Iraqi Bombs
An Iraqi defector has told a London newspaper that the Iraqi dictator Saddam Hussein has two operational nuclear bombs, and is working to build others. The defector is a military engineer who previously helped to oversee the program. He says that the bombs are being built in Henin, near the Iranian border, and involve scores of factories. The news has taken the international community by surprise, and has not been confirmed.

[Jessica Barry, Sydney Morning Herald, 29 January]

Australian Journal of Physics
A journal for the publication of original research in all branches of physics

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The Physicist Volume 38, Number 2, March/April 2001
**LEP: THE END OF AN ERA**

**STUART TOVEY**

Research Centre for High Energy Physics
University of Melbourne

**Introduction**

The Large Electron Positron Collider (LEP) at the European Laboratory for Particle Physics (CERN) near Geneva was built primarily to study the $Z^0$, one of the three carriers of the Weak Force. The other two are the $W^\pm$. This it has done supremely well, and this article summarises some of its greater achievements.

In LEP counter-rotating beams of electrons and positrons are accelerated in the 27 km circumference ring. The cover picture shows the position of the ring with respect to Geneva and the Jura Mountains. At four points the $e^-$ and $e^+$ collide head on and four large experiments are located at these points. One of these (DELPHI) is located close to Geneva airport and exactly on the Franco-Swiss border. A photo of DELPHI during part of its installation is shown in Figure 1.

![Fig. 1. The DELPHI detector during its construction phase (Photo CERN)](image)

However, as ever greater precision was extracted from the machine the CERN physicists, and in particular the accelerator staff, have discovered some bizarre side effects. For example the energies of the circulating beams depend on the phase of the moon and on the level of water in Lake Geneva. And it could be used to time the departure of trains from the railway station. We also describe a few of these unexpected results.

**STUART TOVEY** obtained his B.A. from the University of Cambridge and his Ph.D. from the University of Bristol in the U.K. He joined the School of Physics at the University of Melbourne in 1975 and is currently a Reader and Associate Professor, and a member of the Experimental Particle Physics Group. Dr Tovey's ongoing interest for about 30 years has been experiments in High Energy Physics, mostly at the European Laboratory for Particle Physics (CERN) near Geneva, where he is at present working on an experiment searching for neutrino oscillations. He has also worked at major laboratories in the USA, the UK and Japan, and has published over 100 papers in leading, refereed journals.

**The Cross-section for $e^+e^-$ Collisions**

![Fig. 2. The cross-section (cm$^2$) for $e^+e^-$ as a function of the cms energy (GeV)](image)

Figure 2 shows the cross-section for $e^+e^-$ collisions as a function of the centre-of-mass energy ($\sqrt{s}$). In a symmetric collider like LEP where $E_+=E_-$ this is simply: $\sqrt{s} = 2 \times E$. Apart from some (important) structure the cross-section falls like $s^4$ and even that simple observation has profound physics implications; it tells us that the electron and positron act like point particles without any perceptible dimensions. In natural units ($\hbar/(2\pi) = c = 1$) an area like a cross-section is measured not in (say) m$^2$ but in GeV$^2$. On dimensional grounds the cross-section can only depend on $s^4$ (which has units GeV$^4$) if the electron itself has no dimensions.

The large spike in Figure 2 at $\sqrt{s} = 90$ GeV is the $Z^0$ pole where LEP operated for 6 years. These runs produced over $2 \times 10^6$ examples of $Z^0$ decay and resulted in over 600 papers.
In 1995 superconducting RF cavities were installed allowing the e+e- to be accelerated well beyond 50 GeV, and LEP II was created. The goal was to produce pairs of W particles (e+e- → W+ W-), and in doing so measure their mass to greater precision than was possible at the only previous source of W's: p p collisions. That process has a threshold at √s = 160 GeV and so needed E = 80 GeV per beam.

Finally LEP was “hunting the Higgs”. In LEP’s last year the energy was pushed to the very limit (E = 104 GeV) in an attempt to find the “holy grail” of Particle Physics, the Higgs Boson, more usually called simply “the Higgs”. The Higgs Mechanism, introduced by Peter Higgs of Edinburgh University in the early 1960s, allows particles in the Standard Model of Particle Physics to have finite masses. Ironically just about the only parameter not predicted by the mechanism is the mass of the Higgs itself. Tantalising hints of a signal for the production of the Higgs appeared in the last months allocated to LEP.

**LEP and the Z^0**

As the carrier of the weak neutral current the Z^0 plays a central role in high energy particle physics and the Z^0 mass is a fundamental constant of nature which we would like to know to great precision.

The cross-section (or probability) to form a Z^0 peaks when the sum of the two energies is exactly equal to that particle’s mass. The measured mass is M_Z = 91187 ± 7 MeV/c^2. It is known to better than 1 part in 10^6, which, while not the best mass measurement for a fundamental particle, is not bad for one which lives only about 10^9 s.

The Z^0 peak looks narrow in Figure 2, but it has a full width of about 2.5 GeV. Figure 3 shows the peak in more detail as measured by the Delphi experiment. Sometimes the Z^0 decays into pairs of neutrinos which escape the detectors. We know of three species of neutrino, associated with the electron, muon and tauon charged leptons, and the LEP measurements clearly favour just that number.

The three other experiments have similar results to Delphi and, when combined, they yield N_e = 2.993 ± 0.011. That’s only for light neutrinos, but neutrinos heavier than 45 GeV, which could not be produced in Z^0 decay, would be a big problem for cosmology unless they were unstable. (Surprisingly some theories allow N_e to be non-integer but that’s another story.)

LEP also produced a rich harvest of good physics, from searching for supersymmetric particles to probing the theory of the strong interactions: Quantum Chromodynamics. Listing all these achievements is far beyond the scope of this review. A full account of the results from LEP at the Z-pole can be found in ref. 1 which was reviewed in the November/December 1998 edition of this Journal.

**W pair production**

Figure 2 shows a shoulder at √s = 160 GeV. One of the main goals of LEP II was to measure the mass of the W^± better that had been achieved at p p colliders. This it did but only marginally; their errors were ±46 MeV compared to ±62 MeV for the hadron colliders, see Figure 4.

![Figure 4. Measurements of M(W) from LEP and other experiments](image)

**Where is the Higgs?**

The LEP experiments can look for the Higgs indirectly by fitting the distributions of many measured quantities which depend on the Higgs mass, with that mass as a free parameter. The results are intriguing. Figure 5. The χ^2 function prefers a Higgs mass well below 100 GeV and yet the lack of a definite direct sighting indicates a mass above 100 GeV. Taken together this indicates a mass not far above 100 GeV. However note that the horizontal scale is logarithmic.
Terrestrial Tides

Most of us are familiar with the ocean tides that we can observe when we visit the beach. Less familiar is the deformation of the earth due to the same tidal forces. Viewed from above the pole the Equator of the Earth, or a circle at any fixed latitude, is distorted into an ellipse. The tides raised by the Moon and the Sun have different phases. They produce large effects when their bulges coincide, "Spring Tides" which occur about every two weeks when the Moon is new or full, and weaker ones, "Nean Tides" which occur at half Moon.

At the latitude of CERN (46° 15′ N), these tides can cause the radius of the Earth to increase or decrease by up to 25 cm, and can distort the LEP ring. A full analysis (Ref. 2) has to consider the elastic properties of the local rocks and the strains produced in those rocks by the tidal stress. The circumference of the LEP ring changes by ±2 mm, which is a few parts in 10⁴. That change would not matter given the present precision on Mz, but the beam dynamics of LEP amplifies the effect. The fractional change in beam energy is related to the fractional change in circumference via:

$$\Delta E/\Delta C = -1/\alpha \times \Delta C/\alpha$$

where $E_0$ and $C_0$ are the beam energy and the ring circumference in the absence of tidal stress.

The parameter $\alpha$ depends on the LEP beam dynamics and is $\alpha = 2 \times 10^4$ thus providing a strong amplification. Thus the fractional energy change peaks at about 1 part in 10⁴, a significant correction as the mass is measured to that precision. Figure 6 shows the fractional change of beam energy with time, at three periods when the relative phases of the tides raised by the Moon and the Sun were different.

Energy measurements

The vertical spin polarization of beams circulating in LEP (and indeed in any e+e− storage ring) occurs naturally and can reach 25% and above. The circulating electrons produce synchrotron radiation causing the beams to polarize. The precession frequency of the spin in the ring is proportional to their energy and can be measured by controlled resonant depolarization (Ref. 2 and references therein). Accuracies of $\Delta E/E$ of ±10 ppm are obtained. More recently Nuclear Magnetic Resonance (NMR) probes were installed which can achieve even better precision. Much more detail can be found in Appendix B of Ref. 1.

This was done primarily to improve the accuracy with which the masses and other quantities could be measured but it has produced some ‘fun’ physics which will be discussed below.
Water Levels

In order to keep this article within reasonable length limits, this item will only be briefly noted in passing. The level of the water in Lake Geneva, just out of the bottom of the photograph on the cover, produces a torque which distorts the local rocks in which the LEP tunnel is built. As the water level changes, so does the torque. That too causes the beam energy to change, although in a slow, predictable manner.

Passing Trains

In June 1995, when the new NMR probes were used for the first time a strange pattern was noticed. At certain times the LEP energies fluctuated seemingly at random by up to ±5 MeV. After scratching their heads for a while the LEP engineers offered a bottle of champagne as a prize to whoever could solve the mystery.

The prize went to M. Fleury of the Swiss electricity company (EOS) and proved to be due to a well known effect, at least to a few specialists. The solution was recorded in the November 27th, 1995, edition of the weekly CERN Bulletin, and briefly featured in the ‘New Scientist’ of the following week.

The effect was caused by electric trains, and in particular France’s renowned very fast train the ‘TGV’, passing on train tracks a few kilometers from CERN. Current from the trains’ overhead power lines returns to the generator via the train tracks. However, as these are earthed, a fraction of the current (as much as 25%) travels back via the Earth.

The LEP ring is a good conductor and these currents find the ring to be a very good way ‘home’. Figure 7 shows the near perfect correlation between the LEP NMR measurements and the potential difference between the train tracks and the Earth. The figure also shows the large effect due to the departure of a TGV from Geneva. M Fleury’s bottle of champagne was assured!

Conclusions

LEP has had a glorious 12 years as the world’s premier particle accelerator. However the history of high energy physics has shown, time and time again, that opening up a new energy frontier produces new, often unexpected, physics. Now it is the turn of the Large Hadron Collider (LHC) which from 2005 will collide 8 TeV protons with a counter rotating proton beam at the same energy. This machine will operate in the tunnel now occupied by LEP, although with much stronger magnets, 9 T as compared to 0.14 T in LEP. (Larger fields in LEP would have produced unacceptable levels of synchrotron radiation.)

As the French would say: “The king (aka LEP) is dead, long live the king (aka LHC)”.

Acknowledgements

I am particularly grateful to Steve Myers (head of the CERN SL division that operates LEP) for giving me a powerpoint version of his talk on LEP at this year’s European Particle Accelerator Conference. I would like to thank Wilbur Venus (the spokesman of Delphi) for providing several figures.

References


Figure 7 The variation of the LEP beam energy is compared with the voltage between the train rails and earth near CERN
OSCARS FOR SCIENTISTS

On March 26, the 33 Australian scientists whose papers have been most frequently cited by their colleagues were honoured at a ceremony in Canberra. It has been likened to awarding Oscars to scientists.

The event, "Honouring Excellence in Australian Research," honoured 33 highly cited Australian authors, who received "Citation Laureate" awards. These Australian authors have published more than six high impact or world class papers in their fields.

These highly cited papers document significant research results and then become the foundation of discussion and a resource for other research papers worldwide. The Awards are being sponsored by ISI, a Thomson Scientific company which maintains the most comprehensive database of research information in the world. ISI is based in the USA in Philadelphia.

Professor Sue Serjeantson, President of the Federation of Australian Scientific and Technological Societies (FASTS) said that FASTS supported the Awards, as one well-established method for measuring excellent science. The Awards work by counting the number of times a scientific paper is referred to (or cited) in articles and papers by other authors. The more times a paper is cited, the more influential it is. Professor Serjeantson said that excellence in science can be measured in a number of ways. "Counting citations is one way, but some excellent work which has not been frequently cited has led to new industries and new jobs, and to ways of improving the environment," she said.

Australia's Citation Laureates, 1981-98

Honor Roll: Authors of Multiple High-Impact Papers

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Field</th>
<th># of Impact Papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Graham D Farquhar</td>
<td>CRC for Greenhouse Accounting; Research School of Biological Sciences, Australian National University (ANU)</td>
<td>Plant Biology</td>
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<td>Centre for Mathematics and its Applications, School of Mathematical Sciences, ANU</td>
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<td>Professor Donald Metcalfe</td>
<td>Haematology Division, The Walter and Eliza Hall Institute</td>
<td>Immunology/ Haematology/ Oncology</td>
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<tr>
<td>Professor Ken C. Freeman</td>
<td>Research School of Astronomy &amp; Astrophysics, ANU</td>
<td>Astronomy/Astrophysics</td>
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<tr>
<td>Professor Michael A. Dopita</td>
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<td>Professor Jeremy R. Mould</td>
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<tr>
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<td>Department of Pathology, University of Melbourne</td>
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<td>Professor Suzanne Cory</td>
<td>Molecular Genetics of Cancer Division, The Walter and Eliza Hall Institute of Medical Research</td>
<td>Immunology/Oncology</td>
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<tr>
<td>Dr. Paul J. Fraser</td>
<td>CSIRO Atmospheric Research, CSIRO</td>
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<td>Professor J. Malcolm Oades</td>
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<td>Professor Bruce A. Stone</td>
<td>School of Biochemistry, La Trobe University</td>
<td>Plant Biochemistry</td>
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<td>Professor Malcolm T. McCulloch</td>
<td>Research School of Earth Sciences, ANU</td>
<td>Geochemistry</td>
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<tr>
<td>Professor Michael S. Bessell</td>
<td>Mount Stromlo &amp; Siding Spring Observatories, Research School of Astronomy &amp; Astrophysics, ANU</td>
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<td>Professor David R. McKenzie</td>
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<td>Physics</td>
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<td>Faculty of Health Science &amp; Clinical Pharmacology, School of Medicine, Flinders University</td>
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<tr>
<td>Dr. Roger Powell</td>
<td>School of Earth Sciences, University of Melbourne</td>
<td>Geology</td>
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<tr>
<td>Professor David H. Green</td>
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<td>Dr. L. Paul Steele</td>
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<td>Dr. Bruce W. Chappell</td>
<td>Department of Earth &amp; Planetary Science, Macquarie University</td>
<td>Geology</td>
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<tr>
<td>Professor Warrick J. Couch</td>
<td>Department of Astrophysics and Optics University of New South Wales</td>
<td>Astronomy/Astrophysics</td>
<td>8</td>
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<tr>
<td>Dr. Jeffrey N. Ladd</td>
<td>CSIRO Land &amp; Water, CSIRO (Retired)</td>
<td>Soil Science</td>
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</tr>
<tr>
<td>Dr. Neil C. Turner</td>
<td>CSIRO Centre for Mediterranean Agriculture Research, CSIRO</td>
<td>Soil Science</td>
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AUSTRALIAN ACADEMY OF SCIENCE

COMMENTS BY THE PRESIDENT OF THE ACADEMY, PROFESSOR BRIAN ANDERSON, ON THE INNOVATION ACTION PLAN

"This has been a key if not historic moment for innovation in Australia. The National Innovation Summit was another such key moment. Then the Government committed to responding to the Summit's recommendations and considerations. And there was a partnership between business, research, education and Government which continued through the Summit Implementation Group.

At the Summit the Prime Minister challenged us to judge him by his actions in addressing the innovation needs of Australia. Today, I believe we can say that his actions speak far louder than words. These actions touch our businesses, our schools, our universities. They target excellence and they target national priorities, areas where we can do better and/or ought to have been doing better: biotechnology, and information and communications technology.

The policy changes should pay immense dividends in the future. They constitute not just the implementation of a repair program. They include new policies, rather than just the old policies with extra money. They are hugely important symbolically too, declaring to all Australians what is crucial for our future. Speaking for the Australian Academy of Science, I applaud the inclusion, within an integrated package, of measures such as:

- the cash out for SMEs of the R&D tax concession - the use of a 175% concession for incremental R&D
- the doubling of COMET (commercialising emerging technologies fund)
- the doubling of the funding of the Australian Research Council
- the significant expansion, in cash and access terms, of the CRC program
- the infrastructure funds for the almost-blighted university sector

Today, the Government has delivered, as it needed to do, an innovation strategy which can only move Australia forward. It is important, however, that we keep in mind that this is only the beginning. We must continue to work together to ensure we get the most out of today.

Certainly, the Academies are determined to be partners in building the exciting new Australia. This is an Australia in which I hope we soon will see the community honouring the corporate and individual science and technology heroes for their international successes, as we today honour our cricket teams and Olympic heroes.

I hope that there will be general support from not just the business and research communities - but the community as a whole - as the Government works to implement the strategies it has announced today. They will deliver better jobs, greater wealth, better health and a better environment, and a more secure defence.

The next steps are up to those of us working in research and innovation."

Mr Peter Vallée, Executive Secretary
Australian Academy of Science
GPO Box 783
Canberra ACT 2601
mailto: es@science.org.au
Academy's homepage
NOVA: Science in the News
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EDUCATION SECTION

2000 INTERNATIONAL PHYSICS OLYMPIAD

LEICESTER, UK

STUART MIDGLEY,
Head of Delegation,
Deputy Director, RTASO Physics Programme.

The Australian IPhO 2000 Team: David Houseman, Stuart Midgley (Head of Delegation), Arron Cleary (Team Leader), Adele Morrison, Andrew Ferris, Matthew Chapman (Team Leader), Ian Preston, Anthony Phillips.

On June 27, 2000, five year 12 students nationwide and their team leaders departed from Sydney to attend the annual International Physics Olympiad held in Leicester, United Kingdom. Prior to attending the competition, ten days were spent undertaking intense training at the University of Vienna with a five hour theory exam and a three hour laboratory exam sat by the students every day.

With youthful hope and enthusiasm, the five students arrived in London on July 8 and travelled to Leicester to be greeted by the organising committee of the 31st International Physics Olympiad. This marked the start of an exhausting eight-day cultural program which was rudely interrupted by the theory and laboratory exams - each examination was allocated five hours for completion.

The cultural program included trips to Cambridge, Oxford, the sights of London, the Challenge Centre, the National Space Science Centre, a fun park, Greenwich and many other exciting destinations. In addition to these excursions, the students were treated to dance and musical performances and tours of local historical sites and centres. Leicester's history can be traced back to the Iron Age with buildings dating back to the Roman period of occupation which ended during the 5th century.

During the closing ceremony, contingents from the participating countries saw spectacular performances from local Indian and Morris dance companies. The Indian dance group represented the large Indian community living in Leicester, while the Morris dancers demonstrated a more traditional English dance style that involved much vigour, aggression, mock fighting with large clubs and the waving of white handkerchiefs.

A total of 296 participants from 64 countries competed in the 31st International Physics Olympiad. There were 15 gold medals, 11 silver, 42 bronze and 62 honourable mentions awarded overall. While top honours went to China, Australia ranked highly - roughly level with the UK, Germany and the USA. The Aussie team was one of only 12 countries where all competitors performed at a sufficiently high level to receive an award.

The individual awards of Australian Team members were:

David Houseman
Kingswood College, Vic. ............... Silver Medal

Andy Ferris
Toolooa State High School, Qld ........ Bronze Medal

Anthony Philips
Hale School, WA ................. Honourable Mention

Ian Preston
Melbourne Grammar School, Vic .. Honourable Mention

Adele Morrison
Sydney Church Of England Girls Grammar, NSW ...... Honourable Mention

Overall, the students and team leaders had a thoroughly enjoyable and successful Olympiad experience while learning a great deal about the many destinations visited.

Reproduced below is the third question of the IPhO 2000 Theory Exam - a challenging (and topical) question for Australian Physicists:
Gravitational waves and the effects of gravity on light.

**Part A**

This part is concerned with the difficulties of detecting gravitational waves generated by astronomical events. It should be realised that the explosion of a distant supernova may produce fluctuations in the gravitational field strength at the surface of the Earth of about $10^{-8}$ N kg$^{-1}$.

A model for a gravitational wave detector (see figure 3.1) consists of two metal rods each 1m long, held at right angles to each other. One end of each rod is polished optically flat and the other end is held rigidly. The position of one rod is adjusted so there is a minimum signal received from the photocell (see figure 3.1).

![Figure 3.1](image)

The rods are given a short sharp impulse by a piezoelectric device. As a result the free ends of the rods oscillate with a longitudinal displacement $\Delta x$, where

$$\Delta x = \alpha e^{-\mu t} \cos(\omega t + \phi),$$

and $\alpha$, $\mu$, $\omega$ and $\phi$ are constants.

(a) If the amplitude of the motion is reduced by 20% during a 50s interval determine a value for $\mu$.

(b) Determine also a value for $\omega$ given that the rods are made of aluminium with a density ($\rho$) of 2700 kg m$^{-3}$ and a Young modulus (E) of $7.1 \times 10^{11}$ Pa.

(c) It is impossible to make the rods exactly the same length so the photocell signal has a beat frequency of 0.005 Hz. What is the difference in length of the rods?

(d) For the rod of length $l$, derive an algebraic expression for the change in length, $\Delta l$, due to a change, $\Delta g$, in the gravitational field strength, $g$, in terms of $l$ and other constants of the rod material.

(e) The light produced by the laser is monochromatic with a wavelength of 656nm. If the minimum fringe shift that can be detected is $10^{-4}$ of the wavelength of the laser, what is the minimum value of $l$ necessary if such a system were to be capable of detecting variations in $g$ of $10^{-9}$ N kg$^{-1}$?

A non-directional form of gravitational wave detector consists of a sphere of copper-alloy of mass 1168 kg, suspended in a vacuum from a vibration-reducing assembly. Transducers, containing tuned circuits, are attached to the sphere to detect changes in its dimensions. The transducers will, however, pick up all spurious vibrations due to, for example, temperature effects and noise due to electric pick up.

(f) To reduce vibrations due to temperature effects the sphere is maintained at a temperature of 100 mK. By what factor will the amplitude of the atomic vibrations been reduced in cooling the assembly from 300 K?

(g) The sphere is initially cooled to 4.2 K using liquid nitrogen and liquid helium. The temperature, $T$, is further reduced to 100 mK by a refrigeration process, which removes energy from the system at an average rate of 1 mW. Given that the specific thermal capacity, $s$, of the copper-alloy varies directly as $T^2$ at these low temperatures, estimate the time taken for the system to cool from 4.2 K to 100 mK, given that $s = 0.072$ J kg$^{-1}$ K$^{-1}$ at 4.2 K.

**Part B**

This part is concerned with the effect of a gravitational field on the propagation of light in space.

(a) A photon emitted from the surface of the Sun (mass $M$, radius $R$) is red-shifted. By assuming a rest-mass equivalent for the photon energy, apply Newtonian gravitational theory to show that the effective (or measured) frequency of the photon at infinity is reduced (red-shifted) by the factor $(1 - GM/Rc^2)$.

(b) A reduction of the photon's frequency is equivalent to an increase in its time period, or, using the photon as a standard clock, a dilation of time. In addition, it may be shown that a time dilation is always accompanied by a contraction in the unit of length by the same factor.

We will now try to study the effect that this has on the propagation of light near the Sun. Let us first define an effective refractive index $n_r$ at a point $r$ from the centre of the Sun. Let

$$n_r = \frac{c}{c'_r},$$

where $c$ is the speed of light as measured by a coordinate system far away from the Sun's gravitational influence ($r \to \infty$), and $c'_r$ is the speed of light as measured by a coordinate system at a distance $r$ from the centre of the Sun.

Show that $n_r$ may be approximated to:

$$n_r = 1 + \frac{\alpha GM}{rc^2},$$

for small $GM/rc^2$, where $\alpha$ is a constant that you determine.
(c) Using this expression for \( n_r \), calculate in radians the deflection of a light ray from its straight path as it passes the edge of the Sun.

**Data:**

Gravitational constant, \( G = 6.67 \times 10^{-11} \text{ N m}^2 \text{kg}^{-2} \).

Mass of Sun, \( M = 1.99 \times 10^{30} \text{ kg} \).

Radius of Sun, \( R = 6.95 \times 10^8 \text{ m} \).

Velocity of light, \( c = 3.00 \times 10^8 \text{ m s}^{-1} \).

You may also need the following integral:

\[
\int_{-\infty}^{\infty} \frac{dx}{(x^2 + a^2)^{3/2}} = \frac{2}{a^2}.
\]

**Solution**

A) \( \Delta x = ac \cos (\omega t + \phi), \) \( 0.8 = e^{i \phi} \Rightarrow \mu = 4.5 \times 10^{-3} \text{ s}^{-1} \).

b) \( v = (E/\rho) = (7.1 \times 10^{10}/2700) = 5100 \text{ m s}^{-1} \).

At fundamental \( \lambda_{\text{fund}} = 2 \lambda \text{ m} \).

\( f = 5100 / 4 = 1.3 \times 10^4 \text{ Hz} \).

\( \omega = 2\pi f = 8.1 \times 10^4 \text{ rad s}^{-1} \).

d) Change in gravitational force on rod at a distance \( x \) from the free end \( -mg\delta \) from \( m = \rho A \text{d}L \).

Change in stress \( = mg/\delta \).

Change in strain \( = \delta(x)dx = \rho A g / E \).

that is, \( dx \Rightarrow (1 + \rho A g / E )dx \Rightarrow \Delta L = (\rho A g / E)^2 \).

e) At fundamental \( \lambda_{\text{fund}} = 2L \Rightarrow \Delta L = \Delta \lambda_{\text{fund}} / 2 \).

\( \Delta L = 656 \text{ nm} \times 10^6 \Rightarrow \Delta L = 656 \text{ nL} \times (4 \times 10^4) \).

\( \Delta L = (2700 \times 10^{10}) \times 14 \times 10^{10} \Rightarrow \Delta L = 1.9 \times 10^3 \text{ m} \).

B) \( mc^2 = hf = m = \rho A c \).

\( \Rightarrow \rho A g = \text{Gm}/R \).

\( \Rightarrow \rho A g = \text{Gm} \times (1 - \text{Gm} Rc) \).

(1 - \text{Gm} Rc) \Rightarrow f = (1 - \text{Gm} Rc).

b) \( n_r = c / (1 - \text{Gm} Rc) \).

\( n_r = 1 + 2\text{Gm} Rc \), for small \( \text{Gm} Rc \) = i.e. \( \alpha = 2 \).

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**The Physicist** Volume 38, Number 2, March/April 2001

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Highlights of this year's AIP COUNCIL MEETING

The 53rd Council meeting of the AIP was held on February 15th and 16th, 2001 at 12/1 Yale St, North Melbourne. Twenty five delegates attended, including the Executive, Chairs or representatives of State Branches, Convenors or representatives of AIP Groups, the Convenor of the Science Policy Committee, the AIP Education Convener, the editor of the Physicist, Presidents or representatives of four Cognate Societies and Dr Peter Robertson, from the Australian Journal of Physics.

New Members of the Executive
The New President, A/Professor John O'Connor has commenced his term of office following the retirement of Prof John Pilbrow. The new Vice President is Dr Rob Elliman, ANU, the new Treasurer is Dr Cathy Foley, CSIRO TIP Division, and the new Registrar is A/Professor Peter Johnston, RMIT. Contact details for all Executive members are at the front of the Physicist.

Membership Benefits
The Executive is pursuing, with the approval of Council, the provision of a package of benefits to members through a professional company. This is in addition to the joint offer package already negotiated with IOP, which has been taken up by almost 200 AIP members.

Honorary Fellows
The constitution allows for twelve Honorary Fellows of the AIP, at present there are eight. The election as an Honorary fellow of the AIP is a very significant honour. The motion by the Executive to elect Professor Robert Crompton as an Honorary Fellow was passed unanimously. The Council offers its congratulations to Professor Crompton.

Award for Service to Physics
A few years ago the AIP instituted an award for service to the profession of physics; so far Professor Rod Jory has been the only recipient of this award, for his work with the Physics Olympiads.

This year John O'Connor proposed that the award be made to Professor Mike Gore, of ANU, for his work in originating the Questacon and developing it into the National Science Centre in Canberra. The nomination was supported unanimously and Council offers its congratulations to Professor Gore. An occasion for the presentation will be organised with the ACT Branch and the Executive.

Alan Walsh medal for Service to Industry
This new award, an initiative of the NSW Branch, will be clearly advertised as relevant to the industrial aspects of physics. Following the tradition of other AIP awards, it will not have a monetary component. It is for an important contribution by an Australian physicist to the development of a new industry with technological importance and impact or a new technique. The call for nominations is planned for the end of 2001 so that the prize can be presented at the 2002 Congress.

New Data Base and Membership Cards
The long awaited new data base at the Secretariat is now functional. New membership cards issued since January 18th, when the new data base became operational, have our web address, http://www.aip.org.au and our new email address aip@aip.org.au.

AIP Groups
With the official establishment, at Council, of the Physics Education Group, AIP now has six topical groups, which are, in alphabetical order, with their Convenors: Atomic & Molecular Physics (Birgit Lohmann); Condensed Matter (Steve Colicott and Joann O’Connor); Nuclear and Particle Physics (Andrew Stuchbury); Physics Education (Peter Logan); Space, Terrestrial & Solar Physics (Phil Wilkinson); Women in Physics (Suzanne Hogg). Contact details for the Convenors are available from the Hon Secretary.

2000 Congress and Congress Registration Fees
The Adelaide Congress was extremely successful, with 558 registered participants. After discussion on differentials in registration fees for members and non members, Council approved the motion that for the next Congress, non members will pay a penalty on registration, which penalty will become their Associate membership for the next year. It is hoped that many of those qualified to do so will use this opportunity to become full members of the Institute.

2002 Congress
The 2002 Congress will be hosted by the NSW Branch. (The last Congress in NSW was the outstandingly successful 1988 Congress in bicentennial week). The location will be the University of NSW and the dates are July 7th to 12th.

Physics Olympiads
Australian teams continue to perform with distinction in these intellectual competitions. In the International Physics Olympiad our team of five won a silver medal, a bronze medal and three honourable mentions, while the team for the first time the Australian Olympiad scored a silver medal and three honourable mentions. Colin Taylor, now the Director of the Physics program for the Rio Tinto Australian Science Olympiads, stressed in his report that RIASO sees the involvement of the AIP as ‘being crucial to the success, credibility and viability of the Physics Programme’.

Cognate Societies
Although much smaller than AIP, the cognate societies are very active in holding workshops and conferences throughout the year, in addition to participating in Congress. Representatives of the Australian College of Physical Scientists and Engineers in Medicine, the Australian Optical Society, the Australian Society for General Relativity and Gravitation, and the Vacuum Society of Australia attended the Council meeting and reported on the activities of their Society.

The absence of a representative from the Astronomical Society was noted with regret; Jan Olthof suggested that it would add greatly to Congress if ASA could be encouraged to join in.

Open Forum
Following the custom of the last two years, the AIP Council meeting was followed by an open forum to discuss issues of general interest to the physics profession. The discussion on each issue is summarised below.

Critical Issues
Employment: we need to capitalise on the resurgence of jobs in industry; there are shortages in the medical physics area and in photonics. Jobs in photonics often are not publicly advertised so school careers advisers are not aware of the opportunities. Information needs to be sent to parents, careers advisers, prospective students. We need to lobby the Health Department about the shortage in medical physics.

Declining High School Enrolments: there are too few teachers and no requirement or overall plan for inservice training. The Academy of Science and STA are working to develop a national standard for proficient science teachers. Some thought that the support of the Union would be necessary for mandatory inservice training to be accepted.

Communication and Public Relations: the suggestion that we need a dedicated Publicity Officer (separate from the Communications Officer) received considerable support among Council members. The matter was therefore referred to the Executive for further consideration.

It was agreed that the AIP website, so important for our image, is in need of considerable improvement. Should this be done by a graphics web designer? Positions available could be posted on the web page. Figures are needed to show that there really are jobs available in physics. A positive approach is essential, negative comments can destroy much effort in publicity. Information prepared by industrial members of AIP and of cognate societies, eg AOS, who would employ qualified physicists, would be a great support.

The Functioning of the AIP: Groups and Cognate Societies should be mentioned in any AIP brochures which may be produced for publicity purposes. All sections of the physics community need to find ways of working together.

Strategies for Joint Lobbying
It was generally agreed that communications between the AIP and Cognate Societies need to be improved. Branches and Groups need to be informed of the local contacts for the Cognate Societies (and perhaps vice versa). Lobbying as a group (AIP plus cognate Societies) represents numbers of 3500 rather than 2000 for AIP alone. However it needs to be decided how this will happen - will one Society take the initiative and the others join in?

Morna Welch: Hon Secretary
ACT BRANCH
Annual Report 2000

Branch Meetings
Talks this year covered topics, ranging from ultra-small scale semiconductor nanotechnology through to the origins of the universe. The attendance at branch meetings still fell off towards the end of the year, although less dramatically than in 1999. In addition to the above meetings, the Branch sponsored the January 27 public lecture “Almost absolute zero: the story of laser cooling and trapping” which was presented by the 1997 Physics Nobel Prize winner, Prof. Bill Phillips.

Mar 9, Dr Ron Hogg, Visit to the Lower Molonglo Water Quality Control Centre
Apr 2, Dr. Paul Francis, The dark ages of the universe
May 2, Mr Hervey Bagot, The bell - more than meets the ear
Jun 21, Drs John Finnigan & Keith Ayotte, Natural aerodynamics and environmental physics
Jul 27, Dr. Keith Fifield, Using an accelerator for ultrasensitive tracing of discharges from nuclear processing plants
Aug 22, Dr Michelle Simmons, Nanotechnology: physics, chemistry and biology at the ultra-small scale (the Women-in-Physics talk)
Oct 11, Dr. Ping Koy Lam, Teleportation of quantum states
Nov 8, A/Prof Rod Cross, The physics of sport
Nov 29, Barry Williams, AGM after dinner speech, Regiseta Point

Branch Committee
Four Branch Committee Meetings were held during 2000 (March, April, August and October). Although most committee members will continue in their present positions into 2001, there will be some changes. After a generous six years (no pun intended) as Branch Treasurer, Julian Lower has withdrawn from the committee, along with Paul Denehy and Sean O’Byrne. John Taylor has kindly agreed to join the committee as our new Treasurer, and we welcome Rowena Ball as our new Minutes Secretary. I thank all members of the 2000 committee for their time and commitment and encourage others to consider this rewarding activity in future years. In particular, we are looking for someone to follow me as Branch Chair in 2002.

Budget
The Branch has continued to use some of its financial reserves for additional outreach activities, including support for the adopt-a-physicist program, and the payment of AIP membership fees for 1st year PhD students and students participating in the adopt-a-physicist program.

The 2000 budget is attached for consideration. Due to delays beyond our control, the auditor’s report is not yet available at this time. It will be tabled at the next Branch committee meeting.

Prizes and Awards
Bragg Medal Nomination
The AIP Bragg Medal is awarded each year for Australia’s best PhD thesis in physics. This year’s Branch nominate is Dr Michael Walker whose thesis has been forwarded to National Office. Congratulations also to Dr Ying Koy Lam, our nominee from last year, who won the 1999 Bragg Medal. Ping Koy presented a very entertaining talk on the topic of his thesis to a large audience at this year’s October Branch meeting.

Student Prize - top 2nd year physics student
At our April Branch meeting, Prizes were awarded to the top second year physics students from three ACT Universities. Winners were: Justin Taylor from ADFA, Joshua Yar from University of Canberra, and Douglas Grim and Darren Croton from the ANU. Each student received a $100 book voucher from the CO-OP Bookshop, a cheque for $150 from the ACT Branch of the AIP, and one year’s membership of the AIP. All Prize winners were invited to dine with the speaker and Branch members after the meeting.

NSW Award for Postgraduate Excellence
This year’s event was the sixth to be held by the NSW Branch and saw students representing the ACT and each of the NSW universities present a 20 minute talk on their postgraduate research in physics. The ACT Branch nominated Ben Corry as its representative and he returned with the prize. Well done Ben!

Student travel Support
This year, no student members applied for travel support to attend conferences.

Certificates for top Year 12 physics students
Certificates were sent to all colleges and selected high schools for presentation to their top year 12 physics students. These certificates are awarded for excellence in physics and are presented at end-of-year award ceremonies. This year’s certificate is of a new design with an AIP embossed stamp at bottom right.

Outreach Activities
Canberra Careers Market
The Canberra Careers Market was held on 2-3 August. The local Branch had a booth at the market to promote physics as a career option. Students from ANU and ADFA assisted other Branch members to staff the display over two days. Thanks to all who contributed, especially Andrew Papworth and David Brunwell of Physics Faculties, ANU, for their considerable efforts in setting up and supervising the display.

Adopt-a-Physicist (Reported by Ken Baldwin, program coordinator)
The third year of the ‘Adopt-a-Physicist’ programme saw a series of presentations and tours made by postgraduate physics students at 10 ACT Secondary Colleges. The programme was featured in an article in the July/August edition of ‘The Physicist’. Next year we will be looking for some more students and AIP staff members to support this, the ACT Branch’s major outreach program.

Glen Stewart
Mr John Pattison (Publicity)
Dr Olivia Samardzic (Education, Science Policy, Careers)
Mr Craig Tiller (Student Rep. to June)
Mr Stewart Wright (Editorial, Web Page, Science Policy)
The AIP-SA branch has had an active year presenting four Public Lectures, three Member Lectures, a mid-year General Meeting, a Medical Physics tour, a Student Night, a Quiz Night and a launch of a new Physics Student Society at the University of Adelaide. The Education subcommittee has run a Space School, a Teacher Training session and an Exam Wrap-up session in coordination with the South Australian Science Teachers Association (SASTA). We have given encouragement to students in physics through awards, travel grants and support for student activities. Our web page at http://www.physics.adelaide.edu.au/aip-sa/ has been further improved to provide better access to information on branch activities, jobs and physics in general.

Public Lectures
We are pleased to have been able to maintain attendance at our Public Lectures at the order of 300 people, and on one occasion 800 people. There are a handful of key factors we feel are important in maintaining this level of attendance. We select topics of interest to the general public and have been fortunate to find excellent speakers with an ability to reach a general audience. We assist lecturers in preparing their lecture material by inviting them to review our web page on Preparing a Public Lecture at http://www.physics.adelaide.edu.au/aip-sa/PublicLectures.html. We continue to hold our public lectures in Union Hall, a newly refurbished large comfortable lecture theatre having a professional ambiance. Lectures are advertised in the Adelaidian newspaper, on local radio stations, the AIP-SA web site and A4 posters distributed via the web site. The AIP-SA has responded to this opportunity to address a significant-size audience by advertising activities of the AIP which may be of interest to the audience in the welcome portion of the evening's events. Participating in national programs including National Science Week and holding joint lectures with other societies also provides opportunities to address large audiences and advertise upcoming events. Finally, AIP members are invited to dinner with the speaker and the public is invited to visit with the speaker during a supper after the lecture.

A 19% reduction in our operating grant combined with a significant increase in lecturer expenses in support of this successful public lecture series has placed the AIP-SA expenditures significantly beyond our income. It is clear that new revenue sources must be found if we are to continue to provide the level of service that we have provided in the past two years. The branch will consider "gold-coin" collection at our public lectures and seek increased support from local universities and industry. I thank our Meetings Coordinator and Vice Chair, Dr John Patterson, who is largely responsible for creating the following successful lecture series. Additional thanks go to our Secretary, Dr Laurence Campbell, for organizing the post-lecture suppers and for preparing the A4 poster advertisements. Thanks also to Stewart Wright for his extensive work on the branch's web page this year, another key source of event advertisement.

Our opening lecture featured a phenomenal talk by Dr. Robert M. Zubrin, of Pioneer Astronautics entitled "Mars Direct: Humans to the Red Planet within a Decade." This lecture, held with the support of the Centre for Biomedical Engineering of the University of Adelaide and the Astronomical Society of South Australia, attracted 800 people. The entertaining and occasionally controversial talk brought together many areas of science directed at placing man on mars within a ten year time frame.

This year our National Science Week public lecture was entitled "Measuring the Universe with the Hubble Space Telescope," presented by Dr. Brian Schmidt of the ANU Research School of Astronomy and Astrophysics. The talk was fascinating with many beautiful images of the nighttime sky revealed for the first time by the Hubble Space Telescope. Not only were the images riveting, but Brian was able to capture and describe the physics of each image in a very clear concise and accessible manner. The AIP Bronze Bragg Medal for highest achievement in Year-12 Physics in 1999, and certificates of merit for students who obtained the maximum Subject Achievement Score in the 1999 Year 12 Physics examination were presented by Dr. Schmidt at this meeting. Thanks to our awards coordinator, Dr Boris Blankleider, for his organization of the awards.

Our third public lecture entitled "The Subatomic Structure of Matter and the Origin of Mass" by Prof. Anthony Thomas, Director of the Special Research Centre for the Subatomic Structure of Matter (CSSM) provided insights into the activities of the CSSM. Tony described how 98% of the proton mass has its origin in the gluon fields that bind and confine quarks. The Adelaide audience particularly enjoyed learning about the world-class research going on in their own backyard.

In conjunction with the Women in Physics Group, the AIP-SA presented the Claire Corani Memorial Lecture entitled "Nanotechnology" by Dr Michelle Simmons of the School of Physics, University of New South Wales. The lecture illustrated how an understanding of Quantum Mechanics will play a central role in future technological developments and highlighted the new and exciting international research program in Quantum Computing that has recently been established in Australia. Michelle presented the Claire Corani memorial awards at this meeting. Our thanks to Dr Judith Pollard for organizing another excellent Women in Physics lecture series.

Member Meetings
Our opening event this year was a Medical Physics tour at the Royal Adelaide Hospital. A/Prof Tim Van Doorn presented an introductory talk followed by tours of the Radiation and Nuclear Medicine (imaging) departments.

Our second members' event was held mid year. Members lectures provide an opportunity for AIP-SA physicists to learn about new areas of physics at a more involved level than is possible in a public lecture setting. This time, Prof. Peter Teuben of Flinders University presented a lecture on "Laser-Assisted Collision Processes." Peter explained how the technique permits scattering from specific atomic states and provides a means of detecting product states that are impossible to detect by other means.

The annual AIP-SA Student Night featuring the research of the top physics graduate student from each of the three SA Universities continues to be our most popular members' event. Andrew Laffiff of the School of Chemistry, Physics and Earth Sciences at Flinders University opened the evening with a talk on "A Relativistic Model of Pion-Nucleon Scattering." Daniel Badger of the Department of Physics and Mathematical Physics at Adelaide University presented an excellent talk on "Radial Velocity Studies in Meteor Astronomy." Finally, Michael Moody of the Ian Wark Research Institute at University of South Australia presented "Nano-Bubbles and Computer Simulations of Surface Tension." The Silver Bragg medals for highest achievement in the final undergraduate year were awarded to Greg Fee of Flinders University and Ross Young of Adelaide University.

This year we held a midterm AIP-SA General Meeting. Our younger committee members noted that the Annual General
Meeting provided an opportunity for review, but does not allow for an open-ended discussion of AIP policy and direction. Unfortunately this meeting was not well attended by our membership. However, we are grateful for the input provided by the few members that did attend. A particularly important note is a/Prof Robert Vincent's case for focusing on inter-disciplinary and multi-disciplinary lectures such as the Mars lecture. The AIP is in a particularly good position to make such events become a reality. And while we had hoped to have heated debates on questions such as "Should the AIP cater to the 'What's in it for me' group?" it turns out that the best debates were within our Executive Committee meetings themselves. It was decided that we would hold another mid-year General Meeting but in a more informal setting.

In the interests of broadening the scope of AIP-SA activities and hopefully providing an event of interest to young AIP members and potential members, Dr John Patterson went great lengths to coordinate an event entitled "A Wider Range of Career Opportunities for Physicists." Physicists who had successfully moved on to fields outside of mainstream physics were invited to come and tell us how they did it, and what physics skills they have found to give them an advantage in their careers. Dr Tony Butterfield, of the Australian Taxation Office opened the evening and gave us an overview of his career with an emphasis on how his knowledge of physics got him to where he is today. Dr Ian Tuohy, of British Aerospace (Australia) gave us insights into the path that brought him to his influential position.

Finally, Prof John Prescott of Adelaide University placed the former talks into perspective with a review of careers for physicists.

Our final members' event, the Annual General Meeting and Dinner, was held at the Adelaide Institute of TAFE. The after-dinner speaker was our AIP National President, Prof John Pilbrow who presented an informal lecture on "Science Policy in Australia and a Critical Time for Physicists."

**Education Subcommittee**

Our education subcommittee, composed of Susan Cockshell, Mike Ford, Mike Roach, Stephen Russell and Olivia Samardzic, has had another very active year. They organized a Teacher Training session to assist South Australian Science Teachers adopt the new "applications" based curriculum, an Exam Wrap-up session in coordination with the South Australian Science Teachers Association (SASTA), a space school and a Quiz Night.

**Teacher Training**

The teacher training session was well attended with approximately 70 teachers attending the 2.5 hour workshops. The "applications" sessions on Radioactive Dating and the Davison-Germer Experiment were particularly well received. Approximately 40 teachers attended the Exam Wrap-up of the Year 12 Physics exam where teachers had an opportunity to hear and provide feedback on exam answers and marking. Future activities will extend to Primary Education where students are forming their first impressions and ideas on science.

**South Australian Space School**

As in previous years, members of the Education subcommittee participated in running the SA Space School for Year-10 students. Running over three days, the space school involved 36 students in visits to organizations and companies working in space-related activities. This year's activities included tours of RAAF Edinburgh, DSTO, Flinders and Adelaide University research labs, and the Levels Planetarium. A highlight of the activities included model rocket building and launching.

**Quiz Night**

The AIP-SA held its second annual Quiz Night this year, organized by Olivia Samardzic and once again hosted by Dr Stephen Russell. High schools in the Adelaide area were invited to enter teams of 3 to 10 students. Members helped out by setting questions, acting as judges and as markers. Prizes were awarded with a new Perpetual Shield and certificates presented to the members of the best school team. Participation was good with approximately 50 in attendance with 5 secondary school teams competing in the event. For the second year in a row, St. Peters Year 12 boys took first prize.

**Student Representation on the AIP-SA**

Over the past two years, our committee has had significant representation from young members of the AIP. This year's Executive Committee includes two postgraduate students and two undergraduate students. Our postgraduate students made significant contributions to discussions of AIP-SA and AIP issues, policy and science policy in particular. Membership benefits and the general role of the AIP figured prominently in discussions throughout the year. More often than not, their insights have been both established and more senior perspectives and made for many lively debates.

I found our younger members to be quite critical of current practices. They feel the largest single concern facing the AIP is that it has lost its interest, relevance and appeal to the younger generation of physicists. Falling student and graduate memberships reflect not only a lessening of students continuing in physics across the country, but also a turning away from the AIP by those that are involved in the discipline. They feel the AIP is half way between a professional and learned society and as such, the AIP serves neither academic nor industrial physicists adequately. They feel the AIP must take the initiative to grow and change and adapt to the needs of a younger generation. They argue an invaluable part of this process is to heed the younger voices within the Institute, which often provide a new and modern perspective to what is largely an extremely traditional discipline. Moreover they claim that listening to the young is something the AIP seems to struggle with and they fear it will eventually be the AIP's downfall.

I encourage them to remain active in the AIP and create a plan of action to achieve the goals they desire.

These are difficult issues, and I challenge every branch to identify what the AIP does and what the AIP should do. In this way we can feature the core benefits of membership and identify important new directions for the AIP.

**Launch of the Adelaide University Physics Society**

A key aspect of having Student Representatives on the AIP-SA Executive Committee is to extend the success of the Flinders University Physics Club to other SA Universities. This year we are delighted to have participated in the launch of the new Adelaide University Physics Society entitled "Society for Physics, Astronomy, Cosmology and Experimental Deeds" otherwise known as SPACED. Thanks to Melanie Johnson-Hollett for providing the leadership required to make the event a success. Over 50 people attended the event that included a BBQ, Adelaide University Lab tours and a tour of the Centre for the Subatomic Structure of Matter (CSSM).

**AIP Job Clipping Service On-Line**

The South Australian branch of the AIP began electronically posting the AIP Job Clipping Service mailings last year and continued the posting this year. Our page at http://www.physics.adelaide.edu.au/aip-sa/AusJobs.html provides links to scanned images of physics-related job advertisements published in Australian newspapers. The images are in gif format at 200 dots per inch (dpi) and at 66 dpi for fast browsing of the
titles of the ads. Thanks to Prof John Prescott and the AIP for preparing the advertisement collections.

National Congress

Three years ago, our AIP-SA Chair, Dr Ray Proctor, had the foresight to form a separate committee to plan the AIP Congress in 2000. This action empowered the AIP-SA to maintain a high level of local AIP-SA activities, uncompromised by national commitments associated with the Congress. I encourage future State-Branch Chairs considering a Congress to pursue this successful plan of action.

On behalf of the AIP-SA, I thank Prof. Ian McCarthy for chairing the organizing committee in the early stages of planning where the tone of the Congress established its foundation. We are most grateful to A/Prof Anthony Williams for his enormous commitment and contributions as Chair of the committee. Tony’s management of the Congress has been outstanding, and we thank him for creating an environment in which the conferences and participants could achieve success.

Careers Fair at the National Congress

Mike Ford and Olivia Samardzic organized a careers fair at the National AIP 2000 Congress. South Australian based organizations and interstate organizations were invited to participate in the fair through a range of activities centered around a booth running over the first two days of the Congress. Presentations ranged from providing promotional material and in-person advice, to calling for expressions of interests to fill vacant positions.

The fair aimed to expose current and potential students to the wide range and exciting career opportunities available to Physics graduates, and to give employers the opportunity to access the captive audience of potential employees present at the Congress.

This is clearly an important activity for the AIP to pursue at the National level, and could easily become a standard feature of the Congress in future years. The organizers of the fair would like to thank all the contributing organizations for their time and effort, and the Congress organizers for providing the infrastructure and support required to run this event.

Looking Forward

Next year’s committee will have a fresh look as several members of the committee are retiring and several new members are joining the executive committee.

Dr John Patterson will retire from the committee this year. His enormous commitment to meetings and publicity for the AIP-SA will be greatly missed. Mr Stewart Wright will also step down this year. His contributions to maintaining, reorganizing and developing the AIP-SA web pages is most gratefully acknowledged. Mr John Hedditch, Ms Melanie Johnston-Hollitt, and Mr John Pattison are also retiring from the committee and I thank them for their contributions.

I extend my personal thanks to all members of the 2000 AIP-SA committee and I welcome the following AIP-SA 2001 Executive Committee Members to an exciting new year.

Dr Peter Bouwenkort (Chair)
Dr Peter Veitch (Vice-Chair)
Dr Laurence Campbell (Secretary)
Dr David French (Treasurer)
Dr Boris Blankleider Dr Alex Kalloniatis
Dr Shane Canney Dr Waseem Kamleh
Ms Susan Cockshull Dr Derek Leinweber
Dr Michael Ford Dr David Wiltshire
Ms Joanne Harrison Dr Olivia Samardzic
Dr Derek B Leinweber

TASMANIAN BRANCH Annual Report 2000

The Tasmanian Branch has had an active, interesting and at times frustrating year, supporting six public lectures, the teachers’ seminar, schools’ quiz, and promoting Physics in an environment of cut-backs. Ten committee meetings have been held since the last AGM.

Dr Michelle Simmons delivered AIP ‘Women in Physics’ public lectures on “Nanotechnology: Physics, chemistry and biology unite at the ultra-small scale” in Launceston (2nd September) and Hobart (4th September). The Hobart talk was well attended, but the combination of a clash with the AFL Grand Final and poor weather resulted in poor attendance in Launceston. This was the third year of our attempt to bring some interesting Physics to students and the general public in Launceston. I note my appreciation of the assistance of Martin George and the Queen Victoria Museum and Art Gallery for supporting our efforts in Launceston over these years. I am hopeful that we can continue to promote at least one talk in Launceston annually, but I advocate adopting an approach of presenting the talk at a College during school hours, and inviting other College students to attend. We have already planned a similar approach for a Hobart ‘student talk’. I specifically thank Elizabeth Chelkowski for her considerable efforts in getting the ‘Women in Physics’ lectures arranged this year.

Public lectures this year have been “The future of Thermoelectric refrigeration” by Emeritus Professor Julian Goldsmith (24th May), “The TIGER Radar and its role in Space Weather Studies” by Professor Peter Dyson (29th May), “Australian Climate Variations - forecasts and the oceans” by Dr Stuart Godfrey (14th June) and “X- and Gamma-Ray Astronomy: European Space Initiatives” by Professor Ruediger Staubert (5th October). Tonight’s talk “Civilisation Transformed: The Impact of Quantum Mechanics” will be presented by Professor Geoff Opat. I note my appreciation of lecturers who give freely of their time and wisdom, the Physics group at the University for the support of these functions by allowing us to utilize their facilities, and specifically note the support of Ian Newman and Bob Delbourgo in facilitating our use of those facilities.

For the third year we have been able to schedule the Branch AGM with a members’ dinner and a Public Lecture. I hope this approach can continue and I thank Elizabeth Chelkowski for arranging the dinner and Bob Delbourgo for his efforts in arranging the talk by Professor Opat.

We continue to make specific efforts to promote Physics within the schools. All southern colleges are notified by mail-out about our Public Talks, but I am hopeful that our new initiative of promoting talks at the Colleges during school hours will enable us to reach a larger audience. This year we have prepared and distributed a brochure promoting “Physics Opportunities” in Tasmania. I believe that Southern Tasmania is fortunate to have a number of excellent Physics-based research groups which are promoted in the brochure, copies of which are made available. It has been pleasing to hear the Tasmanian government boasting the fact that Hobart has more scientists per population that any other Australian capital city; at least they appear to view that as something positive. Despite this local advantage, the discipline of Physics is facing considerable pressures both locally and throughout Australia. I will return to this issue, after concluding description of our activities.

The 8th Annual Physics Quiz for year 11 and 12 students was held this year at Launceston Church Grammar School on the 9th of September. Thirteen teams of three or four students from around the state competed for medals and prizes. We received much appreciated sponsorship from Comalco, the Australian Antarctic Division, CSIRO Marine Science, the Queen Victoria Museum.

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and Art Gallery and the Bureau of Meteorology for this promotion. There is a lot of work involved in staging the Quiz and I am grateful to all who enthusiastically assisted. All committee members contributed massively either on the day of the Quiz and/or in preparing for it, but I would like to specifically thank those outside the AIP for their contribution. Adrian Cooper arranged access to Launceston Church Grammar School facilities when our initial venue could not accommodate a necessary date change. Judy Whelan again provided valuable assistance in chasing up schools and preparing certificates. Martin George gave freely of his time to open the Quiz. We continue to receive excellent feedback from teachers for the Quiz and if we can maintain our commitment it will remain an interesting and valuable day for the students.

The annual AIP/RACI professional development seminar for Tasmanian year 11/12 physics and chemistry teachers was held in Launceston, and the 'Physics Day' was on the 6th December 99. These seminars provide Physics and Chemistry teachers with interesting talks on some local research topics, and provide a forum for discussion of issues of concern and for sharing strategies that have worked in the classroom. Ian Newman continues to facilitate the Branch's association with this excellent annual meeting and I thank him for his efforts. Peter Jarvis gave a presentation on the quantum hall effect, Elizabeth Chelkovska provided feedback on the Quiz results and I spoke on the aurora and its upcoming viewing opportunities (which have not been as extensive as I believed likely). This years seminar is being held in Hobart, principally organised by RACI (passed onto the Chemistry Department), but with Ian again carrying the AIP organisational workload.

I thank Marc Duldig for his ongoing efforts in ensuring that our Branch activities are reported in "The Physicist". Tasmania appears regularly in the Branch News section solely because of the efforts of Marc.

Ian Newman has maintained and expanded the Branch web site at:

www.phys.utas.edu.au/physics/AIP_TasBranch

The web site contains information on upcoming talks, reports on branch activities and policy details. In addition, it now contains the questions (not answers!) from the latest Quiz, an initiative proposed at the 1999 AGM, and profiles of Tasmanian Physicists that have been added.

Steve Newbery re-investigated a needed discussion on the 'value for money' of AIP membership with an article in 'The Physicist'.

We have provided some financial support for the Tasmanian Science Talent Quest, the Don College Science Playoff and for the Physics third year prize. We also supported "Switched on Science" and continue to support Tasmanian participation in the Science Olympiads via the Royal Society of Tasmania.

John Humble advises that, "Audit documents for years 1995 to 2000 were handed to the Auditor, Mr Rendall Rydge of Max Peek and Associates, in early October. At that time they were promised back on October 24th. Mr Rydge indicated on October 30th that other work load had prevented him from attending to the AIP documents thus far." We continue to maintain the committee minutes in such a way the financial commitments made and concluded are consolidated near the beginning facilitating understanding of our finances.

There is a considerable amount of volunteer work associated with our activities and I thank all committee members for their generous assistance. I specifically thank John Humble for taking the work-load associated with National Council meetings while I have been Branch Chairman I pay particular tribute to Andrew Klokocnik who is not seeking to continue on the committee next year. Andrew has contributed significantly over the years particularly with his efforts to carry the organisational burden of the Quiz for a number of years. He has been a willing volunteer throughout his time on the committee. Andrew is presently at Davis, Antarctica, deploying the exciting Doppler-Rayleigh lidar and will focus his efforts in the immediate future on getting that world-class instrument performing optimally.

I mentioned in my initial sentence that the year was in part frustrating. On a purely administrative front the introduction of ABN's with the GST caused administrative difficulty with the organisation of the Quiz. We believe we will be able to register for an ABN without incurring a significant reporting burden and the new Committee will be pursuing that option. Of more concern to me is the erosion of our research infrastructure and the funding of research positions. The Physics discipline at the University of Tasmania will be reduced to three lecturers in 2001. This seems axiometrically unsustainable. Prof Pilbrow, the AIP National Chairman has written to the Vice-Chancellor of our concerns. While we fortunately still maintain a wide array of active post-graduate, physics-related, research groups in Tasmania, I think all major Physics-related groups in the University, Antarctic Division, Antarctic CRC and CSIRO have either suffered significant cuts, massive in the case of the University Physics Discipline, or are under considerable threat. All this while additional valuable instrumentation such as the Lidar and TIGER radar have been deployed or installed this year. Our local difficulties have national analogs and there is now a range of positive reports highlighting these difficulties and proposing remedies. I have handed out copies of the National AIP Science Policy which includes a list of these reports.

I have enjoyed my time as Branch Chairman and am heartened by the volunteer efforts of our committee, and the support that we have received. I particularly thank Steve Newbery who has been Branch Secretary these past years for his work and in providing both ideas and feed-back on mine. With certainty, there are exciting times ahead and I wish the new Branch Chair enjoyment and success.
AN OPPORTUNITY FOR PHYSICS

A W BUTTERFIELD
Assistant Commissioner for Taxation
(Small Business)
Canberra.

The Current Situation

I recently saw a copy of “The Australian and New Zealand Physicist” and found it extremely depressing reading. When I completed my PhD in the late 1960’s, man had just landed on the moon, we had the International Geophysical Year, technology was leading the charge into the future and all was rosy in the world of physics. Physics was a highly regarded discipline studied by the best and brightest - it was even an asset for chatting up girls.

Having ceased to practice science, and becoming a “Lapsed Physicist” with my entry into the management ranks in the late 1970’s, I have had only social contact with the physics profession. I was extremely surprised to read of the very parlous state of the profession, with departments amalgamating, funding scarce and jobs even scarcer.

The Environment

I have worked as a senior bureaucrat, often close to government, for almost three decades, and was disturbed to find that the issue of “The Australian and New Zealand Physicist” which I read (and one issue may not be a valid sample) repeated the standard plea for support, which are common to all occupations and industries which happen to be in decline. It talked of the need for more funding and opportunity, the glories of undoubtedly notable past achievements, how our world standing in the profession had declined etc etc.

Unfortunately such messages are repeatedly fed to politicians and their bureaucratic advisors on almost a daily basis by special interest groups, and invariably fall on deaf ears. They are equally true of Latin teaching, blacksmithing or sugar growing. If lobbyists are to be successful they need to offer solutions, not problems which can only be solved by additional funding. To be moved to action, the recipients of the messages need to be told how a course of action will help support and benefit them, not how it might relieve the supplicant.

Where have all the physicists gone?

One solution may well lie in looking at where all the expensively educated physicists have gone, and what they achieve - and there are plenty of examples of this. Probably the Australian physicist best known to the community is Dr Ziggy Switkowski, a leading executive in the telecommunications industry, who features almost daily in the papers.

Dr Switkowski is simply one who has clearly reached the very top in the business world, but there are disproportionately large numbers in the layers of management just below the top in almost every large organisation. The Australian Taxation Office, where I am currently an Assistant Commissioner, is not unexpectedly dominated by lawyers and accountants, yet of the five senior executives with PhDs, there are two physicists, an engineer, and a mathematical/computer scientist! This is not atypical. The PhDs are only the most visible (they have the title!). When you get to know people in management it invariably turns out that a surprisingly large number have scientific qualifications, often at the honours or masters level.

Why are they so successful

If one asks “Why is it so?” the answer becomes readily evident and very obvious. People trained in the physical sciences (especially at postgraduate level) are generally

- highly numerate
- good at problem solving
- logical thinkers
- capable of learning quickly
- analytical thinkers
- innovative
- etc etc

These skills are regarded as extremely valuable in the community and the commercial world, and those who possess them can expect to be sought after and well remunerated.

These skills and characteristics, which are so valuable, and which are well developed in physical scientists, are to some extent independent of the subject matter which was the medium used to acquire them.
There are certainly many senior managers who are aware that physicists and like graduates have these skills and are actually keen to employ them, but I am sure that many are unaware of the valuable and marketable skills which are abundant in physics departments.

What else do they need?

Obviously a physicist cannot simply walk into a reasonably senior management position - if they could physics departments would be overflowing with the best and brightest of our youths desperately competing for entry.

What I find disappointing is that our young graduates do not know what else they need, and can only find out (like I did) by trial and error and a modicum of good luck. I went to a university open day to find out how the woefully managed laboratory in which I worked could be better run, and ended up enrolling for a Master in Business Administration.

The additional skills can be found in most business and management courses.

Accounting and financial management skills are essential in almost any professional career. They are relatively easy to learn and are a breeze to any one who can understand calculus, matrices etc. Much of accounting can be treated as a very simple branch of mathematics. A highly numerate graduate will find financial analysis both interesting and challenging. It is widely believed in some sectors of the financial services industry that a Ph.D. in science is essential for serious investment risk analysis.

Project management is similarly essential whenever there are projects to be managed, which is pretty well everywhere something must be designed and built to meet defined needs, budgets and timeframes. The 'something' may be a technological device, a building or even a piece of legislation. This is another straightforward skill commonly supported by intuitive computer programs.

As most work is not done within a single organization, contract management skills are essential.

An understanding of law is not difficult for a physicist, who is usually able to distil the principles and not get bogged down in the superabundant detail. (Two years after taking responsibility for legal management of insolvency and debt collection I was not only speaking at, but also chairing, national conferences.)

Wherever one works outside the academic world, it will be most likely as part of a team, and often the professional will soon be in a supervisory or managerial position. This can present a real challenge to any technology graduate, as we often think quite differently from much of the population, and more seriously, we do not really understand human differences. As a group we tend to be swayed more by logic, and less by feelings, than are many of our peers. I can recall being described as one who could batter others into submission with powerful logic, but who would never win their hearts! This was certainly not intended as a compliment! Similarly we respond more to substance than to intuition, and prefer to bring matters to closure and move on to the next challenge, rather than to keep our options open for as long as possible. If you are to persuade and convince others you really do need to understand how both your and their minds work, and how to best convey a message. People will only truly work with and for you if they are persuaded, not if they are simply ordered. An understanding of psychology and human behaviour is easy to learn, but generally a little more difficult to put into practice.

Communication skills are essential. Many scientists have these, Carl Sagan being a classic example. Others would be terrified to face a large and possibly hostile crowd, a press conference, a court or a parliamentary enquiry. Concise and above all, persuasive writing, is indispensable.

One might ask how one can acquire such diverse skills.

In most positions outside the academic or laboratory environments, there are many opportunities for learning on the job, and generally employers who think you are giving them good value will be eager to send you on suitable training programs, seminars and conferences - at their expense and in paid work time. This is a lifelong journey and after about thirty years in the workforce, mostly in senior positions, I still put my hand up for training opportunities, as well as learning much more from others at events where I am a speaker, and I expect to do this for many more years. All you have to do is be the volunteer when new programs are offered or new tasks or challenges are available; after all you only have to be the least unsuitable person and you will get the job or opportunity.

The real opportunity

There are abundant opportunities for the physics profession to enhance its relevance, prestige and position in society.

I'd like to suggest that rather than selling physics courses as an opportunity to enter the exciting but possibly diminishing world of physics, there is a much greater potential to sell it as a very valuable path into a wider range of careers, building on the intellectual and learning skills inherent in physics training.

In other words, physics can be sold as an education rather than as training.

This is not a novel idea, as the law faculties have been very successfully selling their studies as an entry into the business world, with enrolments outstripping demand for practising lawyers by a huge margin for many years. There is some irony in this, as law is primarily based on history and precedent, and would seem to be providing precisely the wrong skills for innovative problem solving senior management in a high technology world. (hence all the lawyer jokes such as “you can always tell a lawyer, but generally not very much”)

Approaching local organisations which might employ graduates, and selling the concept to them as a solution to the scarcity of skilled professional staff might help. The engineering profession does this. Obviously this presents some challenges (and would take some people outside their comfort zones), but I suspect there are many grateful lapsed physicists out there in the community who could lend a hand.
There is also a need to sell the profession to students. Potential students of physics should be made aware that once they have graduated, their career opportunities are not limited to physics, and current students need to be exposed to those outside the academia and the laboratory who have based diverse, successful and challenging careers on a foundation of physics.

Physics is very saleable as a useful knowledge base for a great diversity of application. In doing this we must be very aware that the mental skills and techniques which have to be acquired by physicists are far more valuable than the subject matter. New subject matter (be it debt management or demography) can be picked up in a few months by a professional who has been trained to learn - the mental skills of problem solving, innovative thinking etc are the really valuable assets.

A few years in physics at university is a great springboard, not a life sentence (you don’t even get life for murder!).

What’s in it for physics?

Any successful marketing or repositioning of physics as a wider career path can only lead to bigger enrolments (hence more academic jobs and funding) and increased prestige to the profession.

It would also help any lobbying by offering decision makers opportunities, benefits and solutions rather than the usual special interest bleating to which they are subjected almost daily.

There is also great benefit for students. To paraphrase the atrocious lawyer joke above - “you can always tell a lapsed physicist - he’s the one in the well cut suit sitting in first class on the plane!”

An Advertisement in

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AIP CONGRESS REPORT

(Further reports from group convenors, following on from our previous issue)

PLASMA 2000

23rd AINSE Plasma Science and Technology Conference

PLASMA 2000, the 23rd AINSE Plasma Science and Technology Conference, was incorporated into the AIP2000 Congress. The sessions followed the Plenary talk on Plasma Physics by Prof Jeff Harris from the ANU on Thursday and Friday, 14 and 15 December 2000. There were about 32 oral papers and 17 posters covering tokamak and stellarator physics, space plasmas, plasma processing, plasma diagnostics, dusty plasmas and RF plasma physics.

The first keynote speaker was Alan Turnbull, a Flinders graduate now working for General Atomics Inc at San Diego. He spoke on "The Advanced Tokamak Concept" which is shorthand for the close integration of the experimental and computational approach to tokamak physics, incorporating the development of new improved scenarios, such as the negative central shear of the twisted magnetic field. He pointed out the way in which theory and experiment have come together to enhance the ability of tokamaks to sustain plasmas in a state which may lead to new options for the development of fusion energy. For example, active suppression of unstable modes has been predicted by theory and computation and realised in experiments.

Results from the major Australian experiment at ANU, the HI-NF helical axis stellarator, were presented by a number of speakers including Boyd Blackwell. This unique experiment has been upgraded as part of the major Australian facility initiative and has started to produce results at high magnetic field (0.5 Tesla) and will soon enter a phase where the plasma temperature will be increased substantially by electron cyclotron heating.

An opportunity was provided by the circumstances to run a Joint Session with the Solar, Terrestrial and Space Physics group, concentrating on the physics of plasmas in space. Peter Robinson (U. of Sydney) led this session with a talk on the "Stochastic Growth of Localised Plasma Waves" in which he showed that this removes longstanding problems in understanding of persistent unstable distributions, bursty fields, and radio emissions observed in space. Nathan Prior (Flinders University) gave a fascinating talk on "Oscillations of Particles in a Dusty Plasma". For some years the Flinders dusty plasma group have been able to create "crystals" of charged microspheres in well defined patterns, such as seven particles on top of each other. Using a weak driving field, the normal modes of oscillation of these systems were identified.

DSTO presented the ANU plasma group with a unique problem - create an aerial which would minimise the possibility of it being detected by an enemy. Gerald Borg presented a solution to PLASMA 2000 - an antenna made of plasma! Gerald showed that it is quite feasible to generate an RF plasma in a vertical tube without metal-connectors at the top, which could be used to propagate and detect signals. He was able to overcome the interference and noise problems that seem to have plagued previous attempts. Such an antenna would be quite invisible to radar when it is not operating, in contrast to standard metal antennas.

There were a number of very well presented papers from graduate students detailing diagnostic devices for plasmas eg Clive Michael's MOSS camera, Richard Tarrant's optical spectroscopy of a cathode arc and Daniel Andruczyk's supersonic He beam for laser induced fluorescence measurements. However, Andreas Danielson (ANU) was presented with the AINSE medal for the best graduate student oral presentation for his talk on the measurement of the vector magnetic field using Zeeman effect and optical coherence techniques. Felix Cheung (Flinders) was awarded the AINSE medal for the best graduate student poster for "The rotation of dust plasma crystals in an axial magnetic field".

In summary, this was an enjoyable and instructive conference.

Robin Storer
Australian Institute of Nuclear Science and Engineering (AINSE)

18th Nuclear and Particle Physics Conference

The 18th AINSE Nuclear and Particle Physics Conference was very well attended. The interests and activities of the Australian Nuclear and Particle Physics community, which are quite diverse, were discussed in a full program of talks and posters.

Key themes included: CP violation; neutron rich nuclei and physics with radioactive beams; novel nuclear structure effects at high angular momentum; developments in QCD and lattice gauge theory; aspects of heavy-ion fusion and heavy-ion induced fission; the NOMAD experiment and the search for neutrino oscillations; the ATLAS experiment at CERN and the search for the Higgs boson; and some applied physics aspects, mainly concerning detector development for medical and materials science applications.

Along with the local speakers, we enjoyed the contributions of several international visitors, including Professor Janet Conrad and Professor Victor Ninor, who contributed to the Plenary program of the Congress, and Dr Paul Mantica, from Michigan State University, who spoke on physics with rare (i.e. radioactive) isotope beams.

AINSE has a tradition of awarding prizes for the "best" talk and "best" poster presented by a student. Of the 39 talks 15 were presented by students. The standard of talks and posters was very high and those appointed to judge the "best" student presentations had a difficult task. The award for the best poster went to Stewart Wright (Adelaide) for his poster on calculating the sigma commutator from lattice QCD. The award for the best talk was essentially a tie between Jamie Varas (Sydney), who spoke on the use of neural network algorithms to estimate the impact parameter in relativistic heavy-ion collisions, Tom McGregor (ANU), who spoke on K-forbidden transitions in lutetium-176, and Annette Berriman (ANU), who gave a talk on entrance channel effects in heavy-ion fusion-fission reactions. The prize went to Annette Berriman for her relaxed style of presentation and effective use of a computer animation to demonstrate heavy-ion fusion-fission processes.

Together with the academic program, these conferences are an opportunity for extracurricular socialising that inevitably gives rise to antics that help make them memorable. For those present on the Friday afternoon to hear the story, this will always be remembered as the conference where one of the conference lost his contact lenses when someone accidentally drank them in a glass of water!

Andrew Stuckbery

Women in Physics Forum and Dinner

The Women in Physics Forum has been held at the AIP Congresses since 1994 (Brisbane). The Forum provides a mechanism whereby Physicists from across Australia can meet together and discuss issues of importance to women in physics and physics related professions. The AIP 2000 Forum was held on Tuesday the 12th of December with over 60 attendees in the Equinox Restaurant at Adelaide University.

The Forum commenced with informal discussions at each table, while dinner was being served. This was followed by the formal proceedings which incorporated a
presentation of a report on activities of Women in Physics since the last general meeting and the election of the new committee. The 2001/2002 Women in Physics committee will be chaired by Suzanne Hogg, with Deborah Kane as Vice Chair and Manjula Sharma elected to the position of Secretary-Treasurer. The committee includes a representative from each state, with Pina Dall-Armi Stoks holding the position of Women In Physics Lecture Tour Organiser.

The efforts of Judith Pollard, who has chaired the group for the past 4 years, and Ann Roberts, who has held the position of Secretary-Treasurer for the past 6 years, were acknowledged. Pal Fekete was thanked for his work as Women In Physics web page maintainer, a role to be undertaken in future by Elizabeth Chelkowski.

Following the formal meeting, there was a brief opportunity to share ideas arising from the informal discussion. Issues of concern included:

- the lack of gender balance on many decision-making bodies and committees associated with the AIP and cognate societies;
- the importance of raising awareness of the achievements of women in physics, through the Women In Physics Lecture Series and other means;
- strategies for combining a career in physics with family responsibilities.

Janet Conrad, one of the Plenary Speakers at the Congress spoke briefly about the US perspective and the American Physical Society's Committee on the Status of Women in Physics. In particular, she discussed the Site Visit Program 'Improving the Climate for Women in Physics' where, on invitation by a department, 4-6 women would visit to assess the climate of the department, and make recommendations on a variety of formal and informal ways to create a more comfortable environment for women staff and students.

It was felt by many that the allocated time was too short to allow a full and frank discussion of the many issues that were raised. The enthusiasm with which people contributed suggestions served to highlight the importance of meetings such as this. The level of debate indicated the success of the Forum as a vehicle for presentation and discussion of issues, relevant to both women who work within the physics community, and the wider physics community.

Margaret Law

Medical Physics Conference

Besides the level of participation, which was beyond expectations for this first medical physics parallel conference of the AIP Congress, the high level of scientific standards of both oral and poster presentations was noticeable. This, however, did not discourage delegates who did not have specialities in medical physics as the diversity of the presentations was outstanding. Some of the more general medical physics presentations attracted an even bigger audience from a variety of disciplines and also from the public.

The broad selection of interesting presentations ranged from studies of human heart dynamics, the effect of ultrasound on foetal temperature, possible deleterious effects of mobile phones, to the proposed Australian National Proton Project and measurements of human exposure due to cosmic and solar UV radiations.

Dr. Ivanov, Boston University, discussed his research regarding the dynamics of the heart and showed that a proportion of those subjects' hearts measured with rhythmic beats provided more complex hidden structures. The research has thus unveiled that normal heartbeats can hide multi-fractal behaviour, requiring many exponents to characterise their scaling properties. These findings may lead to useful new diagnostic tools. Ultrasound is commonly used to image the foetus. Ultrasound does introduce heat as the energy of the ultrasound waves penetrates the body and most of this heat is removed by arterial flow. Research conducted by Gil Vella at The University of Sydney describes a physical model of the foetus within the body and associated arterial flows. Meanwhile, a representative from the Australian Communications Authority (ACA) described the Commonwealth position on mobile phone regulations. Apparently, the energy deposited due to mobile phones is about one third of that due to AM radio towers. The ACA do, however, plan to adapt plans from Europe that requires mobile phone companies to quote the magnitudes of electromagnetic radiation emitted by each phone. Dr Michael Jackson from Royal Prince Alfred Hospital, Sydney, talked about the feasibility of establishing a proton synchrotron facility in Australia, which would be primarily for patient treatment but would also be suitable for research and commercial applications.

Medical physics postgraduate students from the University of Adelaide took the opportunity to present their research projects that varied from gel dosimetry, novel laser based (transillumination) mammography to new techniques in quality assurance of medical linear accelerators and to calculations of radiation treatment complications due to organ movement and patient set-up errors.

The medical physics section provided a varied and interesting forum highlighting the many possible applications of physics research (and good job prospects) in medical and health sciences. The section was concluded by a tour of the medical physics department of Royal Adelaide Hospital which was fully subscribed by participants. We hope that we can carry this initial momentum into the next AIP conference.

Eva Bezak

OzCUPES at AIP2000

The fifth OzCUPES (Australian Conference on University Physics Education) was held during the first 2 days of AIP2000. For the first time at an AIP Congress, OzCUPES nominated a Plenary Lecture. Professor Dean Zollman from Kansas State University who presented the lecture Quantum Mechanics for Everyone: can it be done with technology.

Dean showed examples of the Visual Quantum Mechanics project through which his group is introducing the concepts of quantum mechanics not only to high school and tertiary physics students, but also to students in fields such as Business Studies who would not usually meet these ideas.

Some of the research and development in Physics Education being undertaken in Australian Universities was presented in papers and posters at OzCUPES sessions. Abstracts of the presentations can be found at http://science.uniserve.edu.au/disc/phys/aipp/f/ozcupes5/. While the scope of this work is very broad, a few themes can be identified.

New ways of arranging and presenting physics courses, both face-to-face and on-line, are being developed and evaluated in several institutions. We heard descriptions and saw examples of some of these developments, and were urged to think about ways of evaluating their effectiveness for different types of students. We also heard about investigations of student understanding in specific areas such as energy, fluids and quantum physics.

One of the sessions introduced an entirely new format to OzCUPES, with delegates participating in a "workshop tutorial" as if they were students. This session was an opportunity to showcase the CUTSE-funded project being undertaken at Sydney University in collaboration with University of Technology Sydney, University of New South Wales, Australian Catholic University and University of Western Sydney.

OzCUPES sessions were attended by up to 60 delegates, most of whom were also participating in parallel conferences. The Congress also provided an opportunity to hold a General Meeting of the Physics Education Group of the AIP. The terms of reference for the group were approved, and the committee for 2001 - 02 was elected. More information about the group may be obtained from the web page http://science.uniserve.edu.au/disc/phys/aipp/f/ozcupes5/.

Judith Pollard
REVIEWS

Prompt Critical

HOLIDAY READING FOR PHYSICISTS

An exceptional triad of physics-related books provided me with most enjoyable reading over the holiday period. First came an intimate view of the life, times and travails of the father of experimental physics revealed in “Galileo’s Daughter” by Dava Sobel. It is a captivating biography based on the almost daily letters to Galileo from his affectionate elder daughter, the Franciscan nun Suor Maria Celeste. Her letters survived, but Galileo’s responses were most likely destroyed by the Mother Abbess of the convent upon the death of his daughter. However, the revelations from this priceless correspondence grant us new insights into a titanic struggle between newborn science and the dogma of an entrenched religion.

Interestingly it was neither the Pope nor the Church that tried and sentenced Galileo, but the Holy Office of the Inquisition - a rather fine point in my view. Sobel has given us a fascinating account of Galileo’s genius and his epochal achievements, presented as a AS22.95 paperback from Penguin Books. It has the ISBN 0-14-028055-1.

Next I read the story of a most ambitious scientific undertaking which took many decades, cost more lives than many contemporaneous wars and could now be undertaken by a satellite in a matter of days. The geodetic triangulation of the Indian subcontinent during the nineteenth century was a monumental task that led eventually to the identification of the world’s highest mountain and bestowed its name as Mount Everest.

Nothing as comprehensive was attempted anywhere else in the world and it was a landmark for the new science of geodesy. The dramatic story of this historic achievement is told in “The Great Arc” by John Keay, author of several books on India and its colourful history. Here the reader is carried along by the awesome challenges faced by the surveyors and their teams, not least being to work under the abrasive George Everest. I detected only one significant error in the book: on page 118 atmospheric pressure is wrongly said to increase with altitude. But this is the only blemish in an absorbing narrative history crying out to be told. Published in hardcover by Harper Collins, “The Great Arc” retails for AS29.95 and bears the ISBN 0-00-257062-9.

Last, in a switch from fact to fiction, I greatly enjoyed the latest SciFi thriller “Revelation” by astronomer Bill Napier. His first book “Nemesis” was acclaimed by Arthur C. Clarke as the most exciting book he had ever read. This one is, in my opinion, even more so with all the right ingredients including some grisly murders and nail-biting suspense. A scientist claims to know how to extract unlimited energy from zero-point energy. You can imagine the lengths powerful forces would go to acquire such a secret. With that lure the plot almost builds itself by Napier has skilfully introduced enough side issues to build a gripping tension and a compulsion to get stuck into the next chapter. Published as a substantial paperback by Headline at AS27.35 it has the ISBN 0-7472-7563-7.

You don’t have to wait until the next holiday season to read and enjoy these fine books.

Colin Keagy
Reviews Editor

Reviews

The Science and Applications of Acoustics

Daniel R. Raecheil
xiv + 598 pp., AS147.26 (hardcover)

Acoustics is a wide-ranging subject, and this book attempts the ambitious task of giving an account, not just of the basic theory, but also of most of its major applications. The target readership is at advanced undergraduate or early graduate level, and the pedagogical aim is reinforced by inclusion of an occasional worked example or a dozen or so problems at the end of each chapter. The problems are, however, not intrusive, and the book can also be regarded as a useful information source.

The basic theory -- strings, rods, plates, waves, tubes, etc. -- is disposed of in a capable fashion in the first third of the book and provides a suitable background for the applications that follow. These span a wide range -- acoustic measurement, human hearing, architectural acoustics, noise control, underwater acoustics, ultrasound, music, and vibration control -- each of these topics getting a single chapter, except for architecture and noise control, each of which gets two. Individual chapters could usefully be read by someone with adequate general background and would provide a good introduction to the particular application discussed.

As might be expected in such a large and diverse book, there are some things with which a reviewer will not agree. I found a few minor errors of fact, and rather too many instances of poor English expression or grammatical errors. The book uses a mixture of metric and Imperial units, which is confusing (can you guess what dBkY/dk means?) but does provide a two-page conversion table.

For anyone who wants a broad and up-to-date introduction to the many applied aspects of acoustics, I can recommend this book. It would also be a good text for a graduate-level survey course.

Neville Fletcher
R S Phys S E
Australian National University

Frontiers in Magnetism

Y Miyako, H Takayama & S Miyashita (eds.)
Physical Society of Japan, Tokyo 105 Japan
vi + 416 pp., Yen 12,000 (A4 hardcover)

This physically large book is a Supplement (A) to the Journal of the Physical Society of Japan. It contains fifty nine papers covering the topics of metallic magnetism, glassy magnetism and quantum magnetism.

It purports to be a summary of the international cooperative research projects on magnetism between Japan, Germany, France, Netherlands and the USA. Most of the papers were received at the beginning of the year 2000, but it is an up-to-date compilation by many prominent workers in the field. Why it has been published as a separate volume is not clear. The papers are a addition to the original literature, what J. M. Ziman termed in the preface to his classic textbook Principles of the Theory of Solids as "those copious, if muddy, sources". Many of the papers in the book will be of interest to those working in the field of modern quantum magnetism, but science librarians would be advised to purchase a copy only if their customers specifically request one.

Andrew Stewart
Department of Applied Mathematics
Australian National University

GEMA: Birthplace of German Radar and Sonar

Harry von Kroge
Translated and edited by Louis Brown
I o P Publishing, Bristol 2000
x + 206 pp., UK £45.00 (hardcover)
ISBN 0-7503-0732-3

This is the story of GEMA (Gesellschaft für Elektroakustische und Mechanische Apparate), a company founded by two young
including the hard ferrites, ALNICOs, metallic 3d magnets, rare-earth magnets (with limited discussions on new phases such as the 1.128 and 2.718), and a brief review of some soft magnetic materials. The book concludes with a chapter on Applications, which includes both dynamic and static applications. Sections are found on motors, magnetic separation, magnetic recording etc.

The attempt to 'cover everything' in one book is both a strength and weakness. At one level it does it very well, I applaud the authors, but inevitably some topics receive only scant attention. However Coey's complementary book 'Rare-Earth Iron Permanent Magnets' focuses on rare-earth iron magnets and is ideal to consult when more detail is required about them. 'Permanent Magnetism' is a first class work, with its subject matter presented in a very accessible manner. It deserves and it will find wide appeal with physicists, materials scientists and engineers. It was already on my bookshelf before I was asked to review it.

S J Collochart
Telecommunications and Industrial Physics
CSIRO Lindfield

Magnetic Resonance Imaging: Principles, Methods and Techniques
P Sprawls
Medical Physics Publishing, Madison WI, 2000
xvi + 173 pp., $US 59.95 (hardcover)

Magnetic Resonance Imaging is probably the most versatile non-invasive diagnostic tool in medicine. However, it is also expensive and the physics underlying the astonishing images is often not well understood by operators and radiologists. This is where the present book comes in: as the preface says, its objective is "to help all of us obtain maximum performance and benefit from the advanced and sophisticated MR technology". A bit more than half of the fifteen chapters introduce the basics of MRI. However, it also includes sections on selective signal suppression, MR angiography and functional imaging. All this is complemented by practical chapters on artefacts and safety, and a comprehensive index.

"MRI Principles, Methods, and Techniques" is an innovative teaching text: the writing is simple and clear, and issues are well illustrated in many drawings and 'mind maps' (more complex illustrations of concepts which accompany each chapter). Much of this material is obviously 'read tested' in the classroom. My main gripe with the book is that no references are given. This reduces its value for physicists who would like to follow up on issues. On the other hand, most medical staff involved in MRI will find the book useful. However, its main success is the teaching material - everyone involved in teaching of imaging physics will find the book invaluable.

Tomas Kron
Medical Physics
Newcastle Mater Hospital

The Pursuit of Perfect Packing
Tomaso Asie and Denis Weaire
I o P Publishing, Bristol 2000
xi + 136 pp., UK £17.50 (paperback)

This is a timely book. There is currently a strong interest in nano-structures, that is, material particles in the range of sizes from 10 nm to 10 microns. The behaviour of agglomerate of these particles is governed by their shape, size mode of packing rather than by the detailed crystal structure of the phases. The reason is the very high surface area to volume ratio in entities of this size.

It is fascinating to read (p 15) of the relationship between the Greek egolden ratio for architecture and the shapes created by close packing discs with a diameter ratio which is a simple function of this number, however, in the text, there appears to be a numerical error. The golden ratio is certainly 1.618. This leads (using the given formula) to a ratio of diameters of 0.7265. My measurement of the ratio for the US cent and quarter coins is 0.786.

The discussion of quasi-crystals is accurate and interesting. The defensive reaction from the International Union of Crystallography is, correctly, questioned.

I question the statement (p 89) that X-ray diffraction cannot distinguish between crystalline and amorphous phases of the same material. In the former case the diffraction peaks are broadened because of the small crystal size, but satisfy the Bragg condition, while in the latter case the diffraction pattern provides information on the radial distribution function but does not satisfy the Bragg condition for the crystals.

In general, materials scientists and engineers venturing into the world of nano-structures should read this book as a general introduction to a fascinating field. It is not a textbook, but it does introduce interesting ideas.

T M Sabine
Consultant Physicist
Sydney
Antimatter - the Ultimate Mirror
Gordon Fraser
213pp, AS 43.90 (happly)
ISBN 0-521-65252-9

The prediction of antimatter by Paul Dirac must rate as one of the greatest achievements of the 20th century. The author of this book edited the highly-successful CERN Courier for many years and has now written a superb review on the prediction and discovery of antimatter.

The positron was discovered in the early 1920s, and these days it is trivial to mass produce them. The discovery of the antiproton had to wait until the mid-1950s when a machine with sufficient energy (the Berkeley Bevatron) was built. Then in the early 1980s CERN, and later Fermilab, were able to produce copious numbers: about 10^8 per day in the early years at CERN when proton-antiproton collisions were the key to the discovery of the W and Z.

Yet, suprisingly, it was the creation of neutral antihydrogen in 1995 in which these two particle were persuaded to bind together, that made world headlines in newspapers and magazines such as Der Spiegel. And yet only 10 neutral atoms were found!

The book relates some delightful quotations. Rutherford thought it "regrettable" that the theoretical prediction had preceded the experimental discovery of antimatter.

The story of antimatter is far from over. The Big Bang is thought to have been matter-antimatter symmetric, and yet we live in a matter-dominated Universe. Thanks to Andrei Sakharov we have a theory as to how this could have occurred but its correctness remains to be verified.

No book is perfect, and I found a few typos. For example the quoted ratio of the masses of the top and bottom quarks is wrong. But this is a great "must read" book.

Stuart Tovey
Research Centre for High Energy Physics

Introduction to High Energy Physics (4th Ed.)
Donald H Perkins
Cambridge University Press, Cambridge 1999
xiii + 426pp, AS 98.50 (happly)
ISBN 0-521-62196-8

This is the 4th edition of a classic textbook. It first appeared in 1972 and has been the text from which honour's-level HEP was taught at most universities here, and in many other countries. The previous edition appeared in 1988, just before the start of the LEP accelerator at CERN and other frontier machines in the U.S.A. and elsewhere. These

have greatly increased our knowledge, in particular of the Electroweak Force and of Quantum Chromodynamics. Consequently a new edition was definitely needed.

This edition represents a major rewrite, not just a set of updates. Welcome additions are lengthy chapters on "Physics beyond the Standard Model" and "Particle physics and Cosmology". Despite these welcome and necessary additions the page count has dropped slightly from the 3rd edition. That was achieved by omitting the chapter on "Hadron-Hadron Interactions" and by drastically pruning the Appendices. One of these, the "Table of elementary particles" needed twelve pages in 1987 while two suffice today. That alone shows the progress made in HEP since the earlier edition.

I would have liked to see the chapter "Experimental Methods" significantly longer. However it is about as up to date as can be expected in such a rapidly advancing area. At least it exists, which is not the case with some rival texts. What sets this book apart from its competitors is that the author has both a very good knowledge of theory and understands experimental techniques and limitations far better than most. His intuitive understanding of the subject matter is very evident. I would predict that another generation of teachers and students will welcome this revised text. It is without a peer at this level. I would certainly use it, although I would keep the previous addition to hand for those "lost" appendices.

Stuart Tovey
Research Centre for High Energy Physics

Dueling Idiots and other Probability Puzzlers
Paul J Nahin
xv + 269 pp., US$24.95 (happly)
ISBN 0-691-00979-1

Probability theory has many applications in the sciences, engineering, economics and related disciplines, as well as in everyday life. Many of us find probability puzzles fascinating and at times irritating, especially those that can be simply stated but have complicated and even counter intuitive solutions. This book presents twenty-one such problems from a collection gathered by the author over twenty-five years of teaching a sophomore course at the University of New Hampshire.

Most of the problems are interesting, some are variations on old themes, and all are well within the grasp of undergraduates with some exposure to mathematics and statistics. The author admits to a poor undergraduate background in the area himself and this is reflected in the final example of the introduction where he mistakenly claims that the sum of two (conditional) probabilities is unity.

The twenty-one puzzlers are presented in a personalized roundabout way and the solutions, which occupy approximately one third of the book, are typically long-winded and unnecessarily complicated. The author repeatedly rederives well known formulae for geometric series for example and typically provides all the tedious steps in the evaluation of elementary integrals. The author correctly encourages computer simulation but again includes long-winded and somewhat dated MATLAB programs for most of his problems.

Teachers, undergraduates and even enthusiastic amateurs may find this a useful source book and an inspiration for further probability puzzles. In the reviewer's opinion, however, this book doesn't quite manage to deliver the goods.

Colin J Thompson
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University of Melbourne

Challenges of Human Space Exploration
Marsha Freeman
Springer-Praxis, Chichester UK 2000
xv + 259 pp., UK £26.00 (paperback)
ISBN 1-85233-201-8

The author is Associate Editor of 21st Century Science & Technology, and specifically wrote this positive review of the human role in space to counter an overwhelming negative press given to the recent Shuttle-Mir program.

The first six chapters consider space stations from Skylab, through the Salyut series to Mir. The greatest attention is given to the recent combined US-Russian activities on Mir when the US Space Shuttle was used as a major transporter of crew and cargo to Mir; a time when NASA gained valuable long duration space knowledge relevant to the current International Space Station (ISS).

There is little discussion of physical sciences during joint Mir operations, with most emphasis upon biological and materials science. A brief mention of space radiation monitoring does indicate that this has influenced NASA planning on ISS assembly operations, an immediate future which is detailed in the last chapter.

The book is a popular summary of lessons learnt and issues posed working long term in the isolated space environment. It argues the value of international co-operation, and is a reminder to those who ignore the recent and current human presence in space. If we do not collectively take responsibility for promoting public interest in this aspect of the great
adventure, the author reminds us that we may well go the way of the Ming dynasty, when in 1436 the Emperor ordered a total clamp down on overseas Chinese exploration for want of funds to service "more pressing domestic needs".

John A. Kennewell
Learnmonth Solar Observatory
IPS Radio and Space Services

Magnetic Excitations in Strongly Correlated Electrons
M. Takigawa, K. Ueda and Y. Ueda (eds.)
Physical Society of Japan, Tokyo, Japan 2000
vi + 173 pp., £10.00 (softcover A4)
ISBN 0031-9015

The discovery of high temperature superconductivity by Bednorz and Muller in 1986 gave a significant boost to the already strong research field of strongly correlated electron systems. At the same time it also stimulated renewed interest in low dimensional, and particularly two dimensional, magnetic materials. The flow of this work has now encompassed materials described as spin liquids and spin ladders and many of these materials show long range and high energy spin fluctuations in the absence of magnetic order. The work reported in these proceedings is mostly in this vein and the editors have grouped the offerings under (1) Doped Cuprates (2) Quantum Spin Systems (3) Quantum Impurities and (4) Highly Correlated Metals, Charge Order and Metal-Insulator Transitions. There is a mixture of theoretical and experimental work, the latter consisting mainly of NMR, neutron scattering and ESR Studies.

The volume is in honour of Professor Hiroshi Yasuoka on his 60th birthday. Professor Yasuoka, lately director of the Institute of Solid State Physics in the University of Tokyo, is a long time champion of the NMR technique. He is author of the last paper "Spin and Charge in Exotic Oxides Explored by NMR/MQR Observations" which is a review of the magnetic fluctuations in copper and vanadium oxide materials especially in high TC materials and materials near metal-insulator boundaries.

This is not a volume which gives a broad perspective on highly correlated low dimensional magnetic materials. Rather it is a snapshot of 1999 thinking about the field and of the current experimental techniques employed. It would be simpler if all electrons formed Fermi gases and all magnetism reduced to Pauli paramagnetism, but wouldn't it be boring.

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In Vivo Monitoring for Internal Contamination: New Techniques for New Needs
Nuclear Technology Publishing,
Ashford, Kent 2000
vi + 202 pp., £124.50 (hardcover)
ISBN 1-870965-3

This is the proceedings of a recent international workshop. Following an introductory paper on the role of intercomparisons and intercalibrations in the improvement of internal dose assessment, the book is divided into six sections which address: Mass monitoring in normal and emergency situations; worker monitoring in normal and emergency situations; intercomparison, quality assurance and accreditation; implication of ICRP models in measurements; phantom, calibration and mathematical models; state of the art of the most recent techniques.

The most significant challenge facing the in vivo monitoring programs is the need to improve sensitivity. For example, a lung counting system has been developed at New Mexico State University where they have used broad energy hyper-pure germanium detectors and have been able to reduce the detector thickness, thus reducing the detector background without sacrificing counting efficiencies at energies below 200 keV.

One very useful paper compares the typical minimum detection limit for a range of radionuclides to the limit of incorporation, derived from the Annual Limit on Intake calculated from the dose coefficients published in ICRP 68. This paper also provides a table of the time period during which meaningful in vivo measurements can be made, based on the known biokinetic model of each radionuclide considered.

This book will be of value to those responsible for large-scale in vivo monitoring services or responsible for calibration of such services.

R.S. Smart
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Expert Judgement and Accident Consequences Uncertainty Analysis
L.H.J. Goossens and G.N. Kelly (eds)
Nuclear Technology Publishing,
Ashford, Kent, 2000
96 pp., £55.10 (paperback)
ISBN 1-870965-64-7

The health risk and environmental impact of potential nuclear accidents depend inter alia on:

• the air-borne dispersion of radioactive materials from the source created by the accident,

• the transfers of these materials between different parts of the environment, and

• dosimetry and risk coefficients, where people are exposed to radiation.

In modern times, these factors are all handled by computer codes in particular, the COSYMA code developed for the European Commission. Such codes depend on data, parameters and correlations which have been around for a long time and, although they are continuously under review, they are still subject to uncertainties. Hence, although the results of the codes are always being checked and "validated", they are also uncertain.

Dispersion characteristics depend on wind and weather, and are therefore particularly variable. In olden times, before computers were available for such calculations, estimates for routine releases were based on "most probable" weather conditions, but accident consequences were often calculated on the pessimistic and highly unlikely assumption of continuous atmospheric inversion and the most adverse wind direction. In computer codes, probability distributions are now built into every part of the calculations and are another source of uncertainties in the conditional risk estimates that are thus generated.

This publication will be of particular interest to those working on probabilistic accident consequence assessments, and also to experts concerned with uncertainties in other fields.

Don Higson
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Paddington, NSW
CONFERENCES & MEETINGS

2001

July 1-5  
OECC/IOOC 2001 Conference Incorporating ACOFT  
Sydney  
Contact: OECC/IOOC Conference Secretariat, PO Box 128, Sydney NSW 2001  
Tel: +61 2 9262 2277 Fax: +61 2 9262 3135  
Email: oecciooc@tourhosts.com.au  

July 6-7  
2nd Mathematical Physics Winter Workshop  
Calympso Plaza, Coolangatta  
Contact: cmpworkshop@maths.uq.edu.au  
http://www.maths.uq.edu.au/~cmpworkshop

July 8-13  
4th Edoardo Amaldi Conference on Gravitational Waves, and  
3rd Australasian Conference on General Relativity and Gravitation  
University of Western Australia, Perth  
Contact: Ms D. Greenwood, Dept of Physics, UWA  
Email: amaldi@physics.uwa.edu.au  

July 9 – 18  
Workshop on Lattice Hadron Physics,  
Rhiga Colonial Club Resort, Cairns  
Contact: Mrs. Sharon Johnson, CSSM, University of Adelaide,  
Adelaide SA 5005. Email: LIHP2001@physics.adelaide.edu.au

July 15-20  
15th International Conference on Ion Beam Analysis (IBA-15)  
(Incorporating 12th AINSE Conference on Nuclear Techniques of Analysis)  
Cairns  
Contact: Rob Elliman, ANU  
Fax: (02) 6251 0672; Email: iba2001@anu.edu.au  

Nov 21-23  
Acoustics 2001 – Noise and Vibration Policy  
Canberra

Nov 25 – Dec 2  
ISES 2001 Solar World Congress  
Adelaide  
Contact: Hartley Management Group Pty Ltd  
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